

THE CRITICAL VULNERABILITY OF TECHNOLOGICAL DEPENDENCE: A CULTURALLY DRIVEN PHENOMENON

A Monograph

by

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AY 2014-001

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REPORT DOCUMENTATION PAGE					<i>Form Approved</i> OMB No. 0704-0188							
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1. REPORT DATE (DD-MM-YYYY) 04/22/2014		2. REPORT TYPE SAMS MONOGRAPH			3. DATES COVERED (From - To) JUN 2010 - JUN 2010							
4. TITLE AND SUBTITLE The Critical Vulnerability of Technological Dependence: A Culturally Driven Phenomenon				5a. CONTRACT NUMBER								
				5b. GRANT NUMBER								
				5c. PROGRAM ELEMENT NUMBER								
6. AUTHOR(S) Major Allan B. Carroll, United States Army				5d. PROJECT NUMBER								
				5e. TASK NUMBER								
				5f. WORK UNIT NUMBER								
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) School of Advanced Military Studies 250 Gibbon Avenue Fort Leavenworth KS, 66027-2134					8. PERFORMING ORGANIZATION REPORT NUMBER							
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)					10. SPONSOR/MONITOR'S ACRONYM(S)							
					11. SPONSOR/MONITOR'S REPORT NUMBER(S)							
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for Public Release; Distribution Unlimited												
13. SUPPLEMENTARY NOTES												
14. ABSTRACT Multiple conflicts and consistent multinational interaction has unequivocally shown the United States military to be the best trained and equipped force in the world. Through the integration of satellite and computer technology, another description has also followed: technological superiority. Through multiple iterations of upgrades, the military has embraced this trait and placed emphasis on maintaining and increasing this superiority by leveraging multiple technologies. The technology that stood out more than any other was the derivative of satellites. The military currently relies on satellites for many crucial technologies to include: global positioning systems, satellite communications, unmanned aerial systems, imagery collection												
15. SUBJECT TERMS Technological Dependence, Satellite Technology, Global Positioning Systems (GPS), Unmanned Aerial Systems (UAS)												
16. SECURITY CLASSIFICATION OF: <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%; padding: 2px;">a. REPORT</td> <td style="width: 33%; padding: 2px;">b. ABSTRACT</td> <td style="width: 33%; padding: 2px;">c. THIS PAGE</td> </tr> <tr> <td style="text-align: center; padding: 2px;">(U)</td> <td style="text-align: center; padding: 2px;">(U)</td> <td></td> </tr> </table>			a. REPORT	b. ABSTRACT	c. THIS PAGE	(U)	(U)		17. LIMITATION OF ABSTRACT		18. NUMBER OF PAGES 57	
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					19a. NAME OF RESPONSIBLE PERSON							
					19b. TELEPHONE NUMBER (Include area code)							

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The opinions and conclusions expressed herein are those of the student author, and do not necessarily represent the views of the U.S. Army Command and General Staff College or any other government agency.

ABSTRACT

THE CRITICAL VULNERABILITY OF TECHNOLOGICAL DEPENDENCE: A CULTURALLY DRIVEN PHENOMENON, by MAJ Allan B. Carroll, United States Army, 57 pages.

Multiple conflicts and consistent multinational interaction has unequivocally shown the United States military to be the best trained and equipped force in the world. Through the integration of satellite and computer technology, another description has also followed: technological superiority. Through multiple iterations of upgrades, the military has embraced this trait and placed emphasis on maintaining and increasing this superiority by leveraging multiple technologies. The technology that stood out more than any other was the derivative of satellites. The military currently relies on satellites for many crucial technologies to include: global positioning systems, satellite communications, unmanned aerial systems, imagery collection, and missile defense systems. Unfortunately, as the technology has emerged, so too has an underlying dependence.

This monograph contributes to an understanding of the government's and society's role in perpetuating this dependence. The lens of System Theory enables an understanding of the system consisting of strategic culture, societal culture, and military culture. The relationships between these, seen through their self similarity and feedback loops, have created the ultimate perpetuation. To prove this point, three separate technologies were analyzed: unmanned aerial systems, satellite communications, and global positioning systems.

The three cases showed consensus that strategic and societal culture play a pivotal role in the continuing dependence on satellite technology. Both exhibit influence over the military and each other creating strong bonds. If the emerging well-buffered system is merely identified and not countered the dependence may become a critical vulnerability.

PREFACE

Two personal traits show the irony of the research conducted within this monograph. First, as a self-proclaimed technology junky (who currently has a dual screen computer, a tablet, and a smartphone in front of him), a degradation of technology would severely limit my functionality and motivation. Second, as I have often stated, my major flaw as a Soldier is in the realm of navigation. Simply stated, I was born without an “internal compass.” With this in mind, my initial intention for this monograph was to illuminate options to combat dependency on technology. After cursory research however, I identified that catalysts for the dependence had not been adequately researched or identified. To fix the problem, the issue had to be adequately understood.

I owe many thanks to the individuals who have shared in the completion of this work. I want to thank my monograph direct, Dr. Daniel G. Cox for his direction and inputs throughout the research and writing of this paper. His assistance and the flexibility he provided were invaluable. I would also like to thank my inspiration and unwavering proofreader, my wife, for all of the assistance with the paper and always reinforcing my efforts with additional confidence in my ability.

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ACRONYMS

ACR	Armored Cavalry Regiment
AFDC	Aid to Families with Dependent Children
ATF	The Bureau of Alcohol, Tobacco, Firearms, and Explosives
BfSB	Battlefield Surveillance Brigade
CALCM	Conventional Air Launched Cruise Missiles
DAGR	Defense Advanced GPS Receivers
DoD	Department of Defense
DOTMLPF	Doctrine, organization, training, material, leadership, personnel, and facilities
DSN	Defense Switched Network
GMLRS	GPS Multiple Launch Rocket System
GATS	GPS-Aided Targeting System
GPS	Global Positioning System
ICBM	Intercontinental Ballistic Missile
ISR	Intelligence, Surveillance, and Reconnaissance
JDAM	Joint Direct Attack Munitions
JWICS	Joint Worldwide Intelligence Communications Service
NIPRNET	Non-Secure Internet Protocol Router Network
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
JDN	Joint Data Network
NASA	National Aeronautical and Space Administration
NAVSTAR	Navigation Satellite Timing and Ranging
NSC	National Security Council

NSS	National Security Strategy
PLGR	Precision Lightweight GPS Receivers
SATCOM	Satellite Communications
SIPRNET	Secret Internet Protocol Router Network
TAI	Total Active Inventory
TLAM	Tactical Land Attack Missile
UAS	Unmanned Aerial Systems
UHF	Ultra High Frequency
WAN	Worldwide Area Network

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INTRODUCTION

“Technology is like ‘magic shoes’ on the feet of mankind, and after the spring has been wound tightly by commercial interests, people can only dance along with the shoes whirling rapidly in time to the beat that they set.”¹ This revelation was not penned in Sun Tzu’s opus *The Art of War* or Carl von Clausewitz’s *On War*, but was from a much more startling source. In 1999, Chinese Colonels Qiao Liang and Wang Xiangsui published the statement in the introduction to a document entitled *Unrestricted Warfare: China’s Master Plan to Destroy America*.² The People’s Liberation Army printed this document to both trace the strategic and operational successes of the United States’ military, but more importantly to highlight its current weaknesses. In a strictly military sense, these vulnerabilities were through a presumed strength, technology.

Since the document’s publication in 1999 and translation into English in 2002, the United States military’s reliance on technology has not diminished, but has expanded due to over a decade of successful use in Operations Iraqi Freedom and Enduring Freedom. Currently reliance on satellite technology remains the most critical vulnerability of the military. The actors driving the perpetuation of this dependency may not be readily apparent. While many influences exist, American strategic culture and societal culture play a crucial role. Ultimately, the intertwined American strategic-societal-military culture system both instigated and perpetuated the United States military’s reliance on satellite technology.

Dependency Refined

While the military uses satellite technology for a host of purposes, three uses have gained prominence: unmanned aerial systems (UAS), satellite communications, and global positioning systems

¹Qiao Liang and Wang Xiangsui, *Unrestricted Warfare: China’s Master Plan to Destroy America* (Panama: Pan American Publishing Company, 2002), 1.

²Liang, xvii.

(GPS). These individual technologies have distinct purposes in the military and have influenced both its doctrine and operations.

While all four services utilize unmanned aerial systems, the Army and Air Force remain the most dependent. As it transformed from the division-centric Army of Excellence to the modular brigade-centric Objective Force, the Army substituted unmanned aerial systems for the traditional higher echelon ground reconnaissance assets.³ The Air Force's transition was more visible as the numbers of fighters and bombers decreased, the number of unmanned aerial systems increased exponentially.⁴ Likewise, Air Force pilot training has shifted substantially. In 2009, more UAS pilots were trained than fighter or bomber pilots.⁵

The joint force maintains a balanced level of dependency on global positioning system (GPS) technology. This technology permeates almost every communications networks and navigation system utilized by the military regardless of its sophistication. The communications networks range from the required GPS time input for a traditional frequency hop radio to the feedback mechanism incorporated in the Blue Force Tracker. For navigation in Operation Iraqi Freedom alone, over 100,000 portable GPS units were utilized.⁶ Additionally, the majority of precision munitions are reliant on GPS technology for their guidance systems.⁷

³Allan B. Carroll, "The Cost of an Expeditionary Army: Reduced Corps and Division Reconnaissance and Security," (master's thesis, Marine Corps University, 2013), 9.

⁴"Equipment – 2013 USAF Almanac," *Air Force Magazine*, May 2013.

⁵"Remote Control War: The future of unmanned combat," directed by Leif Kaldor; produced by Leslea Mair. SaskFilm, CBC, 2011.

⁶Thomas A. McGrath, "What Happens if the Stars Go Out? U.S. Army Dependency on the Global Positioning System," (master's thesis, Command and General Staff College, 2009), 2.

⁷Thomas K. Adams, "GPS Vulnerabilities," *Military Review* 81, March-April 2001, 11.

Finally, satellite communications, for both voice and data transmissions, have gained a prominent place in military operations. While a decade ago this technology was only utilized in very limited actions at the tactical level, satellite communications in combat are now the preferred method of communications due to their reach, reliability, and data capacity. While traditional line of sight communications system ranges have increased, limitations still exist in distance. Due to ultra high frequency (UHF), tactical satellite communications enable a Soldier to communicate with someone on the other side of the world.⁸ At higher echelons, these technologies enable real time video, briefing capability, and real time feedback. Ultimately, this capability enabled increased dispersion at every level regardless of the battlefield geometry.

Vulnerability Illuminated

Unfortunately, an adversary of the United States could capitalize on these dependencies through either satellite disruption or destruction. With a focus on China, the military's current Air-Sea Battle Concept indicates that "The PLA (People's Liberation Army) would first seek to disrupt U.S. battle networks by destroying or jamming the U.S. satellite constellation in concert with coordinated cyber and electronic warfare attacks."⁹ Both the Air Force Scientific Advisory Board and the Defense Science Board Task Force studies concluded that the low signal power of GPS makes it vulnerable to both electromagnetic interference and signal blockage.¹⁰ While not as weak, UAS signals have similar vulnerabilities.

⁸Headquarters U.S. Army. *Multi-Service Tactics, Techniques, and Procedures for Ultra High Frequency Tactical Satellite and Demand Assigned Multiple Access Operations*, FM 6-02.90, (Fort Monroe, VA: Headquarters U.S. Army, August 2004).

⁹Andrew F. Krepinevich, Jan van Tol, Mark Gunzinger, and Jim Thomas, *AirSea Battle: A Point of Departure Concept*, (Center for Strategic and Budgetary Assessments, 2010), 19.

¹⁰Raymond Filler, Steven Ganop, Paul Olson, Stanley Sokolowski, and MAJ William Fisher, "Positioning, Navigation and Timing: The Foundation of Command and Control," (Fort Monmouth, NJ: U.S. Army Command and Control Directorate, 2004), 4.

Satellite destruction, while not as easily accomplished as disruption, is a viable option for near-peer competitors such as China. In 2007, China was the first country in over two decades to demonstrate the capability to conduct anti-satellite operations as it destroyed one of its aging satellites with a ground based missile.¹¹ While this technology was not utilized by the enemy in Iraq and Afghanistan, it still provides a significant threat to future operations.

METHODOLOGY

This study will examine the impact of the system, composed of strategic culture, American societal culture, and the military culture, on the current military satellite technology dependence. The study initiates by analyzing the proposed system against currently accepted literature about System Theory to both define the system and assure its feasibility as a non-linear system. Next, the political science method of controlled comparison was used to analyze three separate case studies. Controlled comparison analyzes multiple case studies, in this case three, to identify agreement or contrast.¹² The analysis is conducted by using similar independent variables to validate and nullify dependent variables.¹³ For this study, the dependent variable is the dependency on satellite technology, while the independent variable is the intertwined American Strategic-Societal-Military Culture System. To conduct this analysis, initially each of the three case studies, unmanned aerial systems, satellite communications, and global positioning system technology, are described both historically and within the context of current military utilization. Next, the system is described in terms of the dependency. Finally, the strategic and societal culture's effects are explained.

¹¹Marc Kaufman, "China Criticized for Anti-Satellite Missile Test," *Washington Post*, (accessed September 17, 2013), www.washingtonpost.com/wp-yn/content/article/2007/01/18/AR2007011801029.html.

¹²Stephen Van Evera, *Guide to Methods for Students of Political Science*, (New York: Cornell University Press, 1997), 68.

¹³Evera, 68.

Limitations

The limitations residing within this study are the limited number of case studies analyzed and an inability to analyze possible competing systems due to time and classification restraints. To further validate the claims within this study, additional dependencies stemming from satellite technology to include imagery gathering, and anti-missile technologies could have been studied. Additionally, the system identified and analyzed could contain many other factors or inputs. Greater yet, additional systems, such as the military industrial complex, may have equal or greater effect on the developed dependencies.

SYSTEM THEORY

System Theory is the accumulation of multiple theories across the spectrum of scientific specialties that ultimately define the traits and actions of systems. Ludwig von Bertalanffy coined the term “system theory” in his book *General System Theory: Foundations, Development, Applications* in 1968. He further clarified that a system is a “set of elements standing in interrelation.”¹⁴ The essence of system theory is the distinction between closed and open systems, and linear and non-linear systems. According to Bertalanffy, closed systems are systems that have been isolated from external factors while open remain affected by their surroundings.¹⁵ Linearity is described in terms of inputs and outputs. In a linear system, a predictable outcome is achieved when specific inputs are administered. A tangible example is an automobile. If the driver turns a key and the fluids are properly filled, there is a reasonable expectation that the engine will start. In contradiction, non-linear systems have cascading effects. The economy has a plethora of inputs, and undetermined outputs from a single interaction. A single input can cause an action that cascades through the system producing unexpected results or “outputs.”

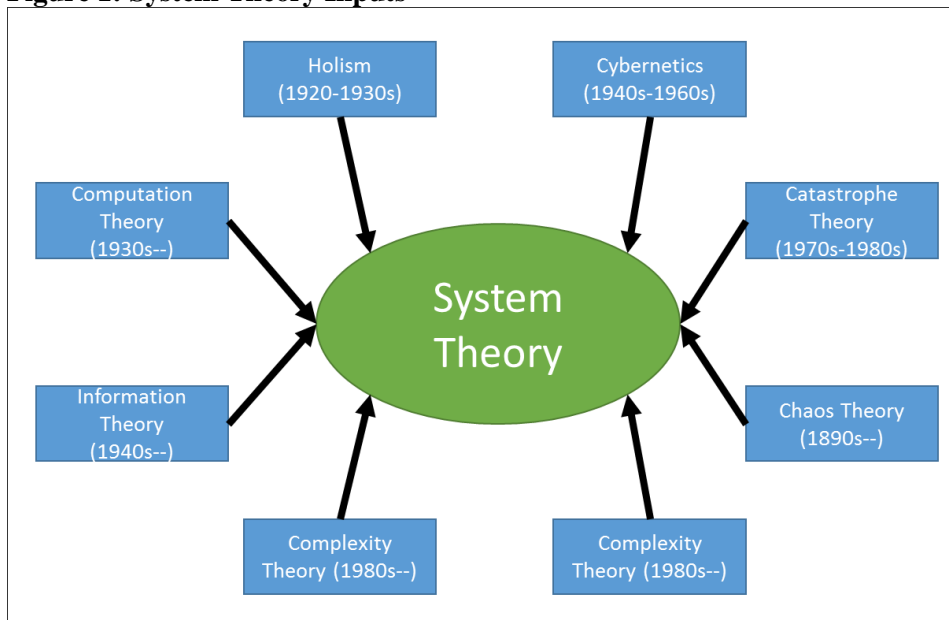
¹⁴Ludwig von Bertalanffy, *General System Theory: Foundations, Development, Applications*, (New York: George Braziller, 1969), 38.

¹⁵Bertalanffy, 39.

Historical Background

The study of system traits can be traced back to the late 1800s and has proceeded through numerous sequential theories that have been incorporated into the overarching System Theory (see Figure 1). There were five crucial theories introduced prior to General System Theory and two following, which enable the general understanding today. Holism, Computation Theory, Information Theory, and Cybernetics were introduced prior to the introduction of System Theory.¹⁶ Chaos Theory and Complexity Theory were derived afterward.¹⁷ A general understanding of the theories and their creators enables a better understanding of systems.

Figure 1: System Theory Inputs



Source: Data adapted from Paul K. Van Riper, “An Introduction to System Theory and Decision-Making,” (Paper presented at the Marine Corps University, Quantico, VA, 2012), 33-34.

The four theories prior to General System Theory spanned a period of seventy years between 1890 and 1960. In 1890, Jules Henri Poincare, a French mathematician and physicist, first began the

¹⁶Paul K. Van Riper, “An Introduction to System Theory and Decision-Making,” (Paper presented at the Marine Corps University, Quantico, VA, 2012), 33-34.

¹⁷Van Riper, 33-34.

study of Chaos Theory which expounds that small differences in initial conditions can cause widely divergent outcomes.¹⁸ The next theory, Holism, is an interdisciplinary approach initially created by J.C. Smut, in 1926, to explain that systems exhibit traits that their parts lack.¹⁹ Following Holism, in Computation Theory, its founder, Alan Turing, utilized mathematics to help visualize the incalculability of many systems.²⁰ In 1948, Claude Shannon's Information Theory further clarified this incalculability through the statistical determination of probability.²¹ In the final theory preceding General Systems Theory, Cybernetics, Norbert Wiener conjectured that feedback was the underlying principle in the technological world.²² This as well as the other theories were incorporated by Ludwig von Bertalanffy in relations to systems overall in 1969.

Two influential theories developed following Bertalanffy's publication were Catastrophe Theory and Complexity Theory. Catastrophe Theory, developed by Rene Thom in 1972, postulated reasons

¹⁸Jessica Howard, "Chaos Theory," *Saint Josephs University*, 2010. (Accessed September 24, 2013). http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=7&cad=rja&ved=0CEsQFjAG&url=http%3A%2F%2Fwww.saintjoe.edu%2F~dept14%2Fenvironment%2Frogero%2Fmth441%2FJessica_chaos.pdf&ei=b55BUv3-O6KMiALys4CQDw&usq=AFQjCNF41fF47LU7VMjcQaiFc93bcwn9OA&bvm=bv.52434380.d.cGE.

¹⁹Marcel Webber and Michael Esfeld, "Holism in the Sciences," Published September 2004, (Accessed September 24, 2013) <http://www.jstor.org/stable/4027878>.

²⁰Lenore Blum, "Alan Turing and the Other Theory Computation," *Carnegie Mellon University*, (Accessed September 24, 2013) http://www.cs.cmu.edu/~lblum/PAPERS/AlanTuring_and_the_Other_Theory_of_Computation.pdf.

²¹Aftab Cheung, Kim, Thakkar, and Yeddanapudi, "Information Theory and the Digital Revolution," *Michigan Institute of Technology*, (Accessed September 24, 2013) <http://mit.edu/6.933/www/Fall2001/Shannon2.pdf>. 2.

²²David A. Mindrell, "Cybernetics: Knowledge Domains in Engineering Systems," *Michigan Institute of Technology*, (Accessed September 24, 2013) <http://web.mit.edu/esd.83/www/notebook/Cybernetics.PDF>.

behind evolutionary changes in systems seemingly in a constant state.²³ In Complexity Theory, Nobel Laureate Ilya Prigogine expanded on Bertalanffy's theory regarding open systems postulating that open systems, unlike closed systems, do not necessarily tend toward entropy, but have the ability to expand and contract.²⁴

Applicable Attributes

While the theories incorporated in Systems Theory yield many different attributes of non-linear systems, several are essential in understanding the conclusions of this study: self-similarity, fractals, feedback, and well buffered systems. Beniot Mandelbrot first coined both the terms “self-similarity” and “fractal” in 1967 and 1982 respectively.²⁵ Self-similarity in non-linear systems refers to relative symmetry between scales.²⁶ The images produced by standing between two mirrors exemplify self-similarity. The image remains but the scale changes. Fractals are the resulting similar attributes created by self-similarity.²⁷ In the above example, the image of the reader's face, while standing between the mirrors, is the fractal. The image of the face becomes progressively smaller but remains intact.

²³Joel W. Robbin, “Thom's Catastrophe Theory and Zeeman's Model of the Stock Market,” *University of Washington Madison*, (Accessed September 24, 2013) http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&cad=rja&ved=0CCkQFjAA&url=http%3A%2F%2Fwww.math.wisc.edu%2F~robbin%2Fcatastrophe%2Fcatastrophe_talk.pdf&ei=1p1BUqSzOuatiGKCK4HYDQ&usg=AFQjCNF92foXAjKPjepX9Jy-StiPGuCFow&bvm=bv.52434380,d.cGE.

²⁴Alberto F. De Toni, and Luca Comello, *Journey into Complexity*, Ebook, 2010, http://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=1&cad=rja&ved=0CC4QFjAA&url=http%3A%2F%2Fwww.diegum.uniud.it%2Fdetoni%2Fdrupal%2Fsites%2Fdefault%2Ffiles%2FJourney%2520into%2520complexity_0.pdf&ei=R59BUrSkDaXBiwLBh4HQDg&usg=AFQjCNE54BetrrZKjoKPnBfQpwq-kNqcZQ&bvm=bv.52434380,d.cGE. 23.

²⁵John C. Russ, *Fractal Surfaces*, (New York: Plenum Press, 1994), 1.

²⁶Benoit Mandelbrot, “How Long is the Coast of Britain? Statistical Self-Similarity and Fractional Dimension,” *Science*, Volume 156, No 3775. 1967, 636.

²⁷James Gleick, *Chaos: Making a New Science*, (New York: Penguin Books, 1987), 98.

Feedback, a requirement within a non-linear system, was coined by Norbert Wiener in 1942 and incorporated into System Theory by Ludwig von Bertalanffy in *General System Theory*.²⁸ Feedback loops enable a system to adapt and normalize over time.²⁹ Bertalanffy uses the example of a thermostat to explain his point.³⁰ As a thermostat is set to a specific temperature, it sends a signal to a heater or air conditioner to initiate a change in the air temperature. The feedback loop is established as the resulting air is gauged by the thermostat to ensure that it has reached the required temperature.

The final attribute of well-buffered systems was defined by Dietrich Dörner in his book *The Logic of Failure*. Dörner describes a well buffered system as a system incorporating multiple feedback loops.³¹ This system has the propensity for self-sustainment and often seems impervious to outside influence.

The Intertwined American Strategic-Societal-Military Culture System

Crucial to this study are the relationships between the sub-systems within the American Strategic-Societal-Military Culture System (see Figure 2). The sub-systems are the American strategic culture, the United States military culture, and the American societal culture. Within this study, a variation of Colin Gray's definition of strategic culture was utilized. He defined "strategic culture" as "modes of thought and action with respect to force [within the United States government]."³² Both the military and societal cultures are defined using the standard anthropological definition of "culture:" a "collective programming

²⁸David A. Mindlell, "Cybernetics: Knowledge Domains in Engineering Systems," *Michigan Institute of Technology*, (Accessed September 24, 2013) <http://web.mit.edu/esd.83/www/notebook/Cybernetics.PDF>.

²⁹Bertalanffy, 43.

³⁰Bertalanffy, 43.

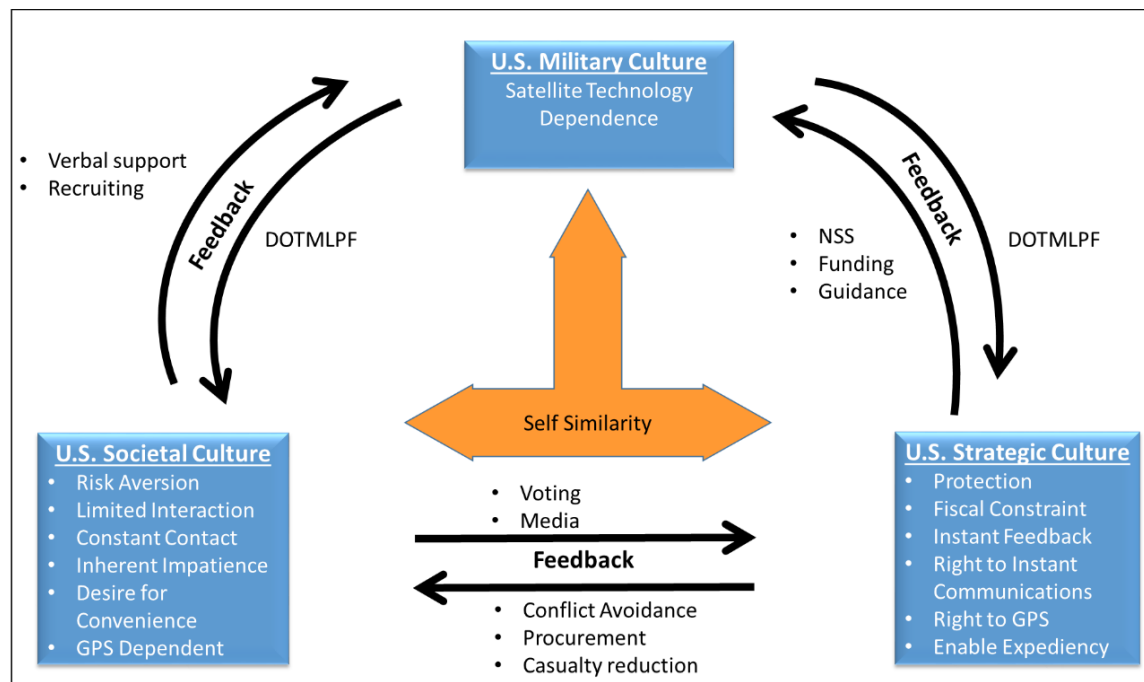
³¹Dietrich Dörner, *The Logic of Failure*, (New York: Metropolitan Books, 1989), 75.

³²Colin Gray, "National Style in Strategy: The American Example," *International Security* 6, no.2 (Fall 1981), 22.

of the mind that distinguishes the members of one group or category of people from another.”³³ These three systems interact to form a distinctly complex non-linear system.

This study hypothesizes that the three sub-systems have self-similarity and feedback loops resulting in the perpetuation of specific technologies. The military then becomes more dependent on these technologies due to the well buffered system created by the three actors. The three case studies utilized clearly show the existence of these properties and display the reasons for the perpetuation of the current dependency.

Figure 2: The Intertwined American Strategic-Societal-Military Culture System



Source: Author created figure

CASE STUDY 1: UNMANNED PLATFORMS

While unmanned aerial systems (UAS) only recently gained international visibility due to ongoing operations in the Middle East, the first documented use of unmanned aircraft in combat was during the American Civil War. Both the Union and Confederacy released balloons laden with explosives

³³Geert Hofstede and Gert Jan Hofstede, *Cultures and Organizations: Software of the Mind*, (New York: McGraw Hill, 2010), 400.

in an attempt to destroy key enemy infrastructure.³⁴ As innovation continued, the UAS proceeded through several guidance methods prior to arriving at the current satellite utilization. From 1917 to 1922, the Navy and Army conducted individual research on “flying bombs” but eventually cancelled the program.³⁵ While the Navy’s variant was cancelled without success, the Army’s UAS, called the “Bug,” successfully conducted multiple training missions.³⁶ The UAS was aimed in a specific direction and would continue to fly until a set number of propeller rotations were performed at which time it would crash, hopefully into the enemy.³⁷ Only 100 were ever ordered and these missed any wartime utilization.³⁸

The British were the first to utilize the second method of control, radio waves.³⁹ In 1933, the Fairley Queen sparked the United States military’s interest.⁴⁰ The Navy began their own research 1936, and launched a radio controlled UAS in 1938 to test the gunners of the USS Ranger.⁴¹ Though the initial program was scrapped in 1944, the guidance method was utilized in subsequent programs by both the Army and Navy and was crucial in UAS utilization during both Operation APHRODITE and Project Anvil during World War II.

³⁴“From U.S. Civil War to Afghanistan: A Short History of UAVs,” *American Forces Press Service*, (accessed January 20, 2013) <http://www.defense.gov/news/newsarticle.aspx?id=44164>.

³⁵John David Blom, *Unmanned Aerial Systems: A Historical Perspective*, (Kansas: Combat Studies Institute, 2010), 45.

³⁶Blom, 46.

³⁷Blom, 46.

³⁸Blom, 46.

³⁹Blom, 46.

⁴⁰Blom, 46.

⁴¹Blom, 47.

In 1955, the Army began testing radar control, in the RP-71, which would for the first time enable aircraft operation beyond the visual range of the controller.⁴² This new capability enabled a transition in utility from a flying bomb and training aid to reconnaissance and surveillance.⁴³ The entire joint community used this method in subsequent UAS programs which enabled their successful use during the Vietnam War.⁴⁴ Firebee drones flew 3,400 sorties over North Vietnam conducting reconnaissance, information operations, and radar detection.⁴⁵ Their success in Vietnam fueled the desire for continued innovation.

The final and most crucial guidance method was satellite control. With its acquisition in 1994, the Predator incorporated a satellite UHF connection, which enabled users to both control the aircraft and access its imagery anywhere in the world.⁴⁶ In 1995, the Air Force's successful employment of the aircraft in Bosnia sparked the explosion in UAS research, development, and acquisition (see Figure 3).⁴⁷

⁴²Blom, 50.

⁴³Blom, 50.

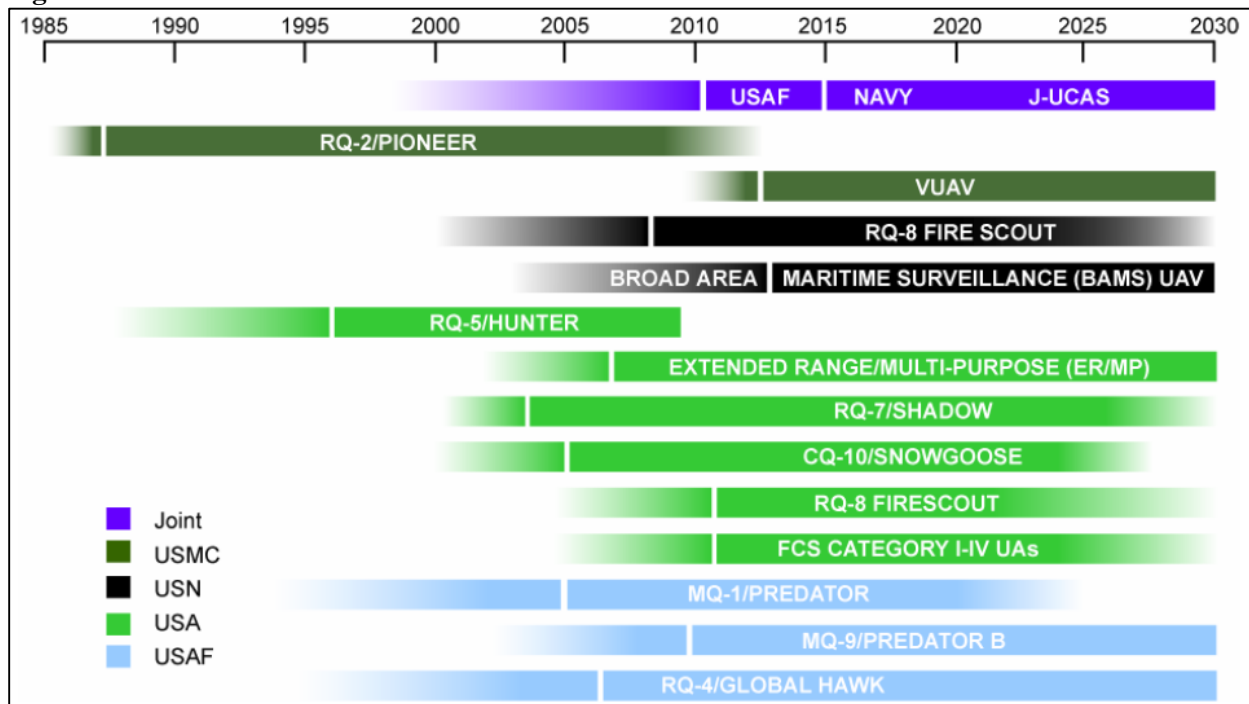
⁴⁴ "From U.S. Civil War to Afghanistan: A Short History of UAVs."

⁴⁵ "From U.S. Civil War to Afghanistan: A Short History of UAVs."

⁴⁶Blom, 93.

⁴⁷Blom, 93.

Figure 3: Timeline of Current and Planned DoD UAS



Source: Headquarters Department of Defense, *UAS Roadmap 2005-2030*, Washington, DC: Headquarters Department of Defense, August 2005, 3.

Current Military Utility

Unmanned aerial systems (UAS) have permeated almost every aspect of joint DOTMLPF with the underlying themes of survivability, protection, and fiscal constraint. By specifically magnifying the origins of the current military doctrine and the present material acquisitions these themes can be adequately scrutinized. Within military doctrine, the *Transformational Planning Guidance*, issued by the Department of Defense (DoD) in 2003, and the *Unmanned Aircraft Systems Roadmap*, published in 2005, adequately lay out the requirements dictated within future joint and service doctrine. In addition, the *Army Operating Concept* and the *Army Capstone Concept*, the foundational documents for the Army, display the implementation. The joint transition in material is best explained through the Air Force transition from manned to unmanned aircraft and the Army transition from manned to unmanned surveillance and reconnaissance.

The *Transformation Planning Guidance* and the *Unmanned Aircraft Systems Roadmap* played two distinct and crucial roles in the restructuring of military doctrine. The *Transformation Planning Guidance* created the overarching framework for the transformation of the individual branches. The document discussed UAS under the larger umbrella of Intelligence, Surveillance, and Reconnaissance (ISR). It broadly stated the need for integrated ISR within asymmetric operations, areas needing deep and or persistent surveillance.⁴⁸ This broad guidance was further clarified in the *Unmanned Aircraft Systems Roadmap*.

The *Unmanned Aircraft System Roadmap* was designed to influence future Quadrennial Defense Reviews (QDRs) and help guide service redefinition of roles and missions.⁴⁹ It indicated that the “lower risk and higher confidence in mission success” were the motivation to continue the expansion of UASs.⁵⁰ It declared that the overarching purpose of unmanned aircraft was to conduct the “dull, dirty, or dangerous missions” required by the joint force.⁵¹ The stated aim was to eliminate the human factors limiting flight hours.⁵² The “dull” refers to long duration missions that would require multiple pilot transitions. The “dirty” indicates missions which would be hazardous to human pilots collocated with aircraft such as nuclear contamination.⁵³ Lastly, while all combat operations contain risk, the “dangerous” includes missions possibly resulting in massive attrition of aircraft or potentially damaging

⁴⁸Headquarters Department of Defense, *Transformation Planning Guidance*, (Washington, DC: Headquarters Department of Defense, April 2003), 10, 32.

⁴⁹Headquarters Department of Defense, *UAS Roadmap 2005-2030*, (Washington, DC: Headquarters Department of Defense, August 2005), 1.

⁵⁰Headquarters Department of Defense, *UAS Roadmap 2005-2030*, 1.

⁵¹Headquarters Department of Defense, *UAS Roadmap 2005-2030*, 1.

⁵²Headquarters Department of Defense, *UAS Roadmap 2005-2030*, 2.

⁵³Headquarters Department of Defense, *UAS Roadmap 2005-2030*, 2.

strategic implications.⁵⁴ The *Army Operating Concept and Capstone Concept* captured and expanded on the Department of Defense mandates.

There were three themes present in the *Army Operating Concept* in relation to unmanned aerial systems (UAS). The first was enabling of maneuver operations specifically through surveillance and reconnaissance operations.⁵⁵ The second was enabling commanders to have real time visual access to the battlefield.⁵⁶ The third and most notable was for survivability of friendly combatants. The concept proclaimed that it must “gain operational advantage and efficiency through the increased use of robotics capabilities and unmanned systems to reduce Soldier exposure to dangerous materials and hazardous incidents.”⁵⁷

The *Army Capstone Concept*’s contribution centered on fiscal constraint and the warfighting function of protection. The document identified that the future would be an “era of fiscal constraint.”⁵⁸ It then further clarified as an assumption, “Fiscal constraints will compel the Army to rebalance modernization, training, and force structure priorities.”⁵⁹ In terms of protection, the concept declared the necessity of investing in protection capabilities to guard forces from threats and hazards.

The Air Force’s transition in material was the most visible of the four services. In 1999, the Air Force’s total active inventory (TAI) for active duty was 1,666 fighter or attack aircraft in contrast with 6

⁵⁴Headquarters Department of Defense, *UAS Roadmap 2005-2030*, 2.

⁵⁵Headquarters U.S. Army, *United States Army Operating Concept*, TRADOC Pam 525-3-1, (Washington, DC: Headquarters U.S. Army, August 2010), 18.

⁵⁶DA, *United States Army Operating Concept*, 17.

⁵⁷DA, *United States Army Operating Concept*, 27.

⁵⁸Headquarters U.S. Army, *United States Army Capstone Concept*, TRADOC Pam 525-3-0, (Washington, DC: Headquarters U.S. Army, 19 December 2012), 1.

⁵⁹*United States Army Capstone Concept*, 5.

UASs.⁶⁰ Thirteen years later, the Air Force had 1,289 fighters and 253 UASs.⁶¹ While the increased numbers of UAS does not fully fill the void left by reduced fighters, the correlation is readily apparent. The reduction in fighters totaled 33 percent of those maintained in 1999, while the gain in UAS was 421 percent.

The Army's transformation was slightly more nuanced. In 2004, it published its *Transformational Roadmap* which stated that, "Unmanned and unattended systems will be used in maneuver, maneuver-support and maneuver-sustainment roles to augment and, in some cases, replace Soldiers."⁶² At the division and corps levels specifically, the introduction of the UAS was one of the underlying catalysts for the restructuring of the Army's dedicated reconnaissance and security assets.⁶³ Prior to Army transformation, which culminated in 2012, the armored cavalry regiment (ACR) and division cavalry squadrons conducted corps and division level reconnaissance and security operations. The ACR was composed of three ground cavalry squadrons and an air squadron in addition to multiple specialty companies (See Figure 4). The division cavalry squadron contained three ground cavalry troops and two air cavalry troops (see Figure 4).

In contrast, the organization that replaced the ACR and division cavalry squadron, the battlefield surveillance brigade (BfSB) only contains a single ground cavalry squadron and a military intelligence battalion, which contains an unmanned aerial system (UAS) platoon (see Figure 5). This massive transition was accompanied by a shift in many reconnaissance and surveillance responsibilities traditionally performed by cavalry units to the UAS.

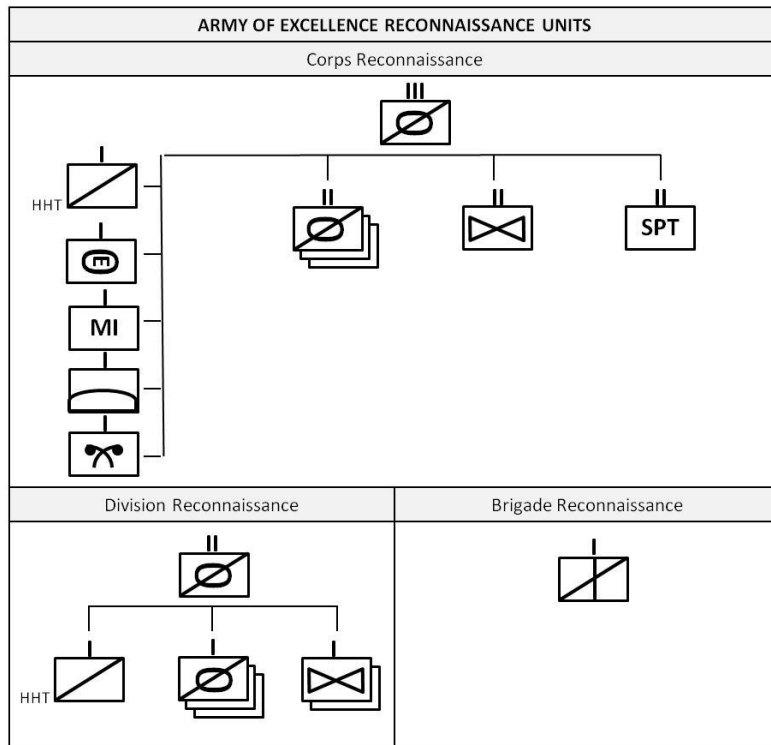
⁶⁰"Equipment – 2000 USAF Almanac," *Air Force Magazine*, May 2000.

⁶¹"Equipment – 2013 USAF Almanac," *Air Force Magazine*, May 2013.

⁶²Headquarters U.S. Army, *United States Army Transformation Roadmap*, (Washington, DC: Headquarters U.S. Army, July 2004), 5-9.

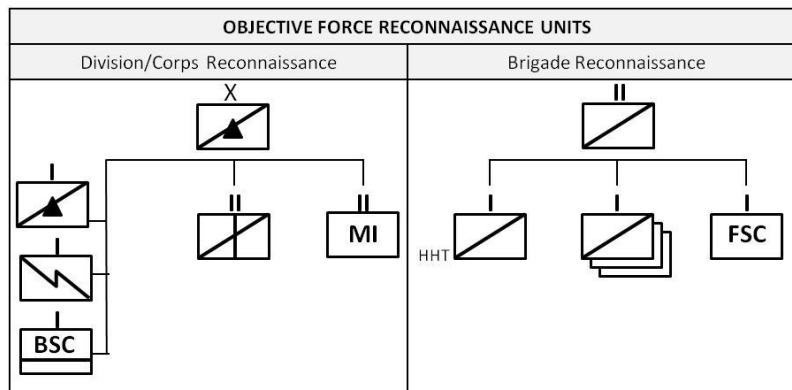
⁶³Allan B. Carroll, "The Cost of an Expeditionary Army: Reduced Corps and Division Reconnaissance and Security," (Master's Thesis, Marine Corps University, 2013), 9.

Figure 4: Army of Excellence Reconnaissance Table of Organization



Source: Allan B. Carroll, “The Cost of an Expeditionary Army: Reduced Corps and Division Reconnaissance and Security,” (Master’s Thesis, Marine Corps University, 2013).

Figure 5: Objective Force Reconnaissance Table of Organization



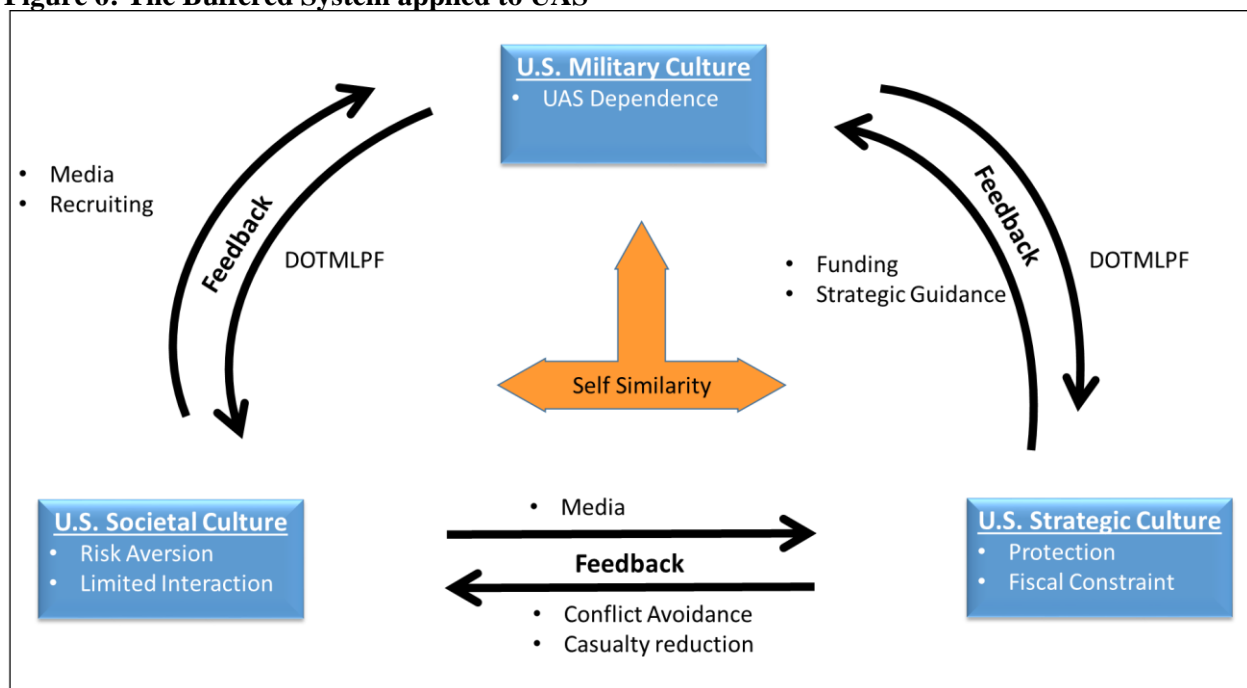
Source: Allan B. Carroll, “The Cost of an Expeditionary Army: Reduced Corps and Division Reconnaissance and Security,” (Master’s Thesis, Marine Corps University, 2013).

The Buffered System

The demonstration of the buffered system through Unmanned Aerial Systems is best described through the factors enforcing self-similarity and the feedback provided (see Figure 6). Self-similarity

appeared between all three cultures in terms of protection, risk aversion, and limited interaction, while only between the strategic and military cultures for fiscal constraint. The feedback provided within the system was delivered through multiple methods. Societal culture's feedback was generally through the media, voting, and military recruiting. The government's feedback was in the funding and strategic guidance provided to the military, and the overarching conflict avoidance, casualty reductions, and observed procurement of the systems. The military's feedback was delivered through the combined DOTMLPF, which dictates and allows the culture to function. To understand the individual cultural traits, the fractals produced, and the feedback mechanisms, the individual cultures must undergo further scrutiny.

Figure 6: The Buffered System applied to UAS



Source: Author created figure

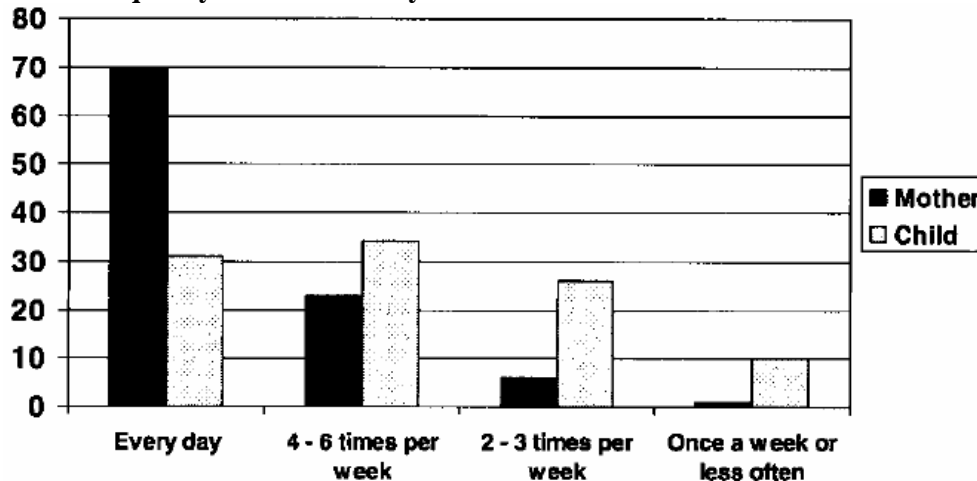
American Culture

Self Similarity

While the connection may initially appear unlikely, the American public has a marked influence on the use of the UAS. American risk aversion and the inherent desire to limit human physical interaction

reside in the American societal culture and display prominently in the creation and perpetuation of the UAS. Two easily identifiable examples of risk aversion stem from a fear of physical harm to our children and a fear of lawsuits. In a recent study, the majority of mothers spent more time outside as children than their kids do currently. While seventy percent of the mothers once played outside daily, only 30 percent of their children currently do the same (see Figure 7).⁶⁴ The reasons surrounding the change centered on fear of physical harm and a concern regarding crime and safety. While 61 percent of mothers restrained their kids due to possible physical harm, 82 percent did so due to a fear of crime and safety concerns.⁶⁵

Figure 7: Frequency of Outdoor Play



Source: Clements, Rhonda. "An Investigation of the Status of Outdoor Play." *Contemporary Issues in Early Childhood*, Volume 5, Number 1, 2004, 72.

Lawsuits have also produced an unhealthy fear in Americans. All actions are now scrutinized to determine the feasibility of negative legal repercussions and as a result, many traditionally enjoyable activities and common business practices have been nullified. Community playgrounds have been stripped of monkey bars, jungle gyms, high slides, seesaws, and other traditional equipment due to

⁶⁴Rhonda Clements, "An Investigation of the Status of Outdoor Play," *Contemporary Issues in Early Childhood*, Volume 5, Number 1, 2004, 72.

⁶⁵Clements, 74.

thousands of lawsuits.⁶⁶ During an annual charity softball tournament in Page, Arizona, a man sued the city for \$100,000 after breaking his leg while sliding into home base.⁶⁷ Even ministers, like Reverend Ron Singleton have had to revise their methods of counseling and comforting the grieving due to fear of litigation. Reverend Singleton has a policy of no hugging for this reason and consoles the lost and grieving with a hand pat.⁶⁸ This fear of reprisal dictates much of what people do and has had a marked influence on their desire to limit physical interaction with others.

Societies' unintentional gradual elimination of human interaction has created an impersonal vacuum and the second influence. Analysis of the transition to digital communications and leisure time allocation clearly indicate the reduced levels of human interaction. Both the Pew Institute and Qualcomm have conducted extensive surveys and studies on Americans older than 15 regarding the drastic shift from voice communications to sending text messages, "texting," on cell phone or other mobile devices. In the United States, texting jumped dramatically from 2000 to 2010, from 14 billion in 2000 to 188 billion in 2010.⁶⁹ Of those surveyed, 32% of Americans would rather text message than talk on the phone.⁷⁰ Validating this assessment, the average American sends and receives an average of 88 texts a day compared to 17 phone calls.⁷¹ Surprisingly, 22% screen all calls and reply via text or email.⁷² According

⁶⁶Stuart Taylor Jr. and Evan Thomas, "Lawsuit Hell," *Newsweek*, (Accessed October 22, 2013) <http://www.yuricareport.com/Law%20&%20Legal/NewsweekHell.html>.

⁶⁷Taylor.

⁶⁸Taylor.

⁶⁹Jeffrey Kluger, "We Never Talk Anymore: The Problem with Text Messaging," *CNN*, <http://www.cnn.com/2012/08/31/tech/mobile/problem-text-messaging-oms/index.html> (accessed October 22, 2013).

⁷⁰Qualcomm, "Your Wireless Life: Results of TIME's Mobility Poll," <http://content.time.com/time/interactive/0,31813,2122187,00.html> (accessed October 22, 2013).

⁷¹Kluger.

to MIT psychologist Sherry Turkle, one of the main issues is that most texting is void of necessary human emotion resulting in the “complexity and messiness of human communications [getting] shortchanged”⁷³

To an even greater extent, the domination of the television in both our leisure time and lives indicates the separation of Americans from human interaction. Currently on an average day, Americans spend 5.37 hours or 22 percent of their time conducting leisure activities (see Figure 8).⁷⁴ Within this timeframe, only 26 percent of the time is spent exercising or socializing and 70% is watching television (see Figure 9).⁷⁵ On average, in a lifetime, an American will watch over 9 years of television.⁷⁶ To sharpen this point, the average school age youth, in 2012, spent 1,200 hours watching television in comparison to 900 hours in school.⁷⁷ Strikingly, out of children surveyed between 4 and 6, 54% would prefer to watch television to spending time with their fathers.⁷⁸ These revelations indicate the strong push to separate the individual from physical interaction, intentional or not, which lends to similarity in the realm of UASs.

⁷²Qualcomm.

⁷³Kluger.

⁷⁴“American Time Use Survey,” *American Board of Labor and Statistics*, <http://www.bls.gov/news.release/pdf/atus.pdf> (accessed October 23, 2013).

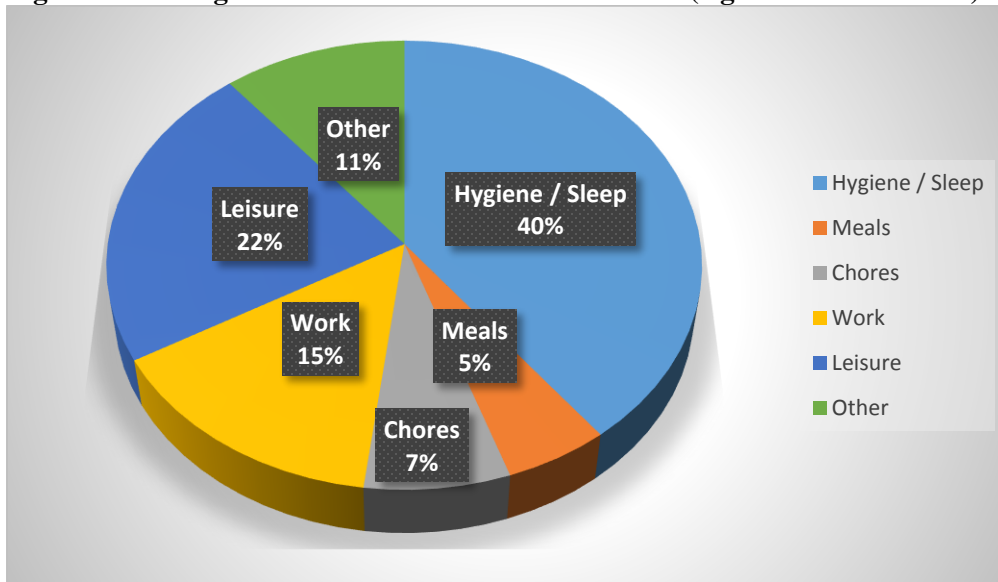
⁷⁵“American Time Use Survey.”

⁷⁶A.C. Nielsen Company, “Television Watching Statistics,” *BLS American Time Use Survey*, <http://www.statistic brain.com>, (accessed October 23, 2013).

⁷⁷A.C. Nielsen Company.

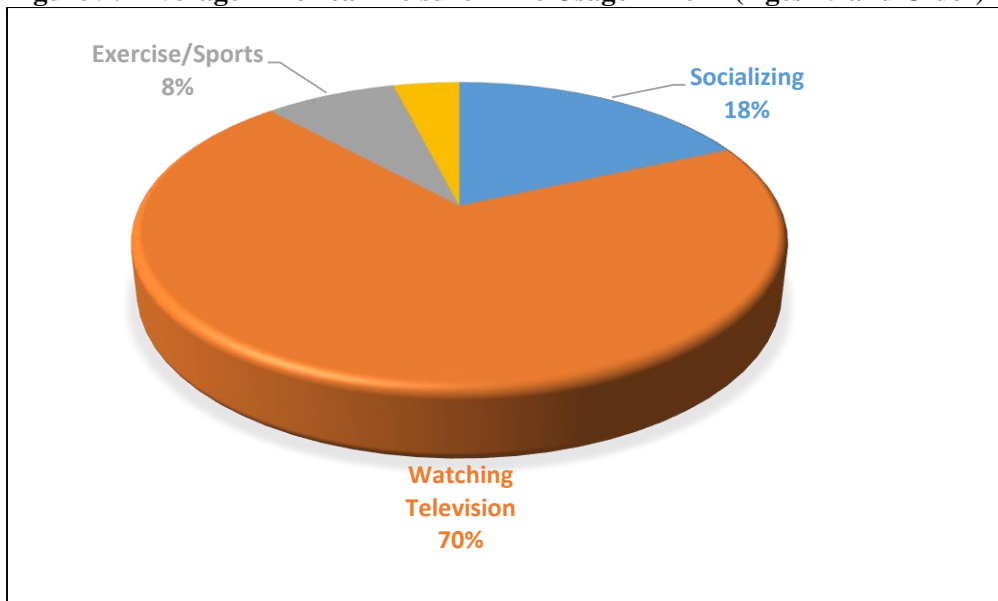
⁷⁸A.C. Nielsen Company.

Figure 8: Average American Time Utilization in 2012 (Ages are 15 and older)



Source: Data adapted from “American Time Use Survey,” *American Board of Labor and Statistics*, <http://www.bls.gov/news.release/pdf/atus.pdf> (accessed October 23, 2013).

Figure 9: Average American Leisure Time Usage in 2012 (Ages 15 and Older)



Source: Data adapted from “American Time Use Survey,” *American Board of Labor and Statistics*, <http://www.bls.gov/news.release/pdf/atus.pdf> (accessed October 23, 2013).

Feedback Mechanisms

The American culture provides feedback to the military through the media and recruitment levels, and to the government through the media and voting. In the case of both the government and military, the

type and amount of media coverage indicates the public sentiment. When the president signed the federal law enabling domestic utilization of UASs in February 2012, a public outcry emerged through all media outlets with hundreds of articles and newscasts.⁷⁹ In contrast, military utilization of UASs in Iraq and Afghanistan received overwhelmingly positive press coverage. Typically, it has highlighted successes in targeting and the reduction of troops in harm's way. Also significant, the government has directed military use of UAS in multiple international capacities, limiting public knowledge and concern, and, in turn, reducing media coverage.

The feedback provided through recruitment levels has indicated societal solidarity regarding the current trajectory of the military. To visualize the current trend, compare the recruitment during the Vietnam War with the two most recent conflicts. Despite the reduced scale when contrasted with World War I or World War II, the draft was required to fill the ranks of the military engaged in combat (see Figure 10).⁸⁰ In contrast, in 2008, as both Operations Iraqi Freedom and Enduring Freedom were ongoing, every component of the military met its projected goal for recruiting.⁸¹ The Air National Guard actually recruited 126 percent of its goal.⁸²

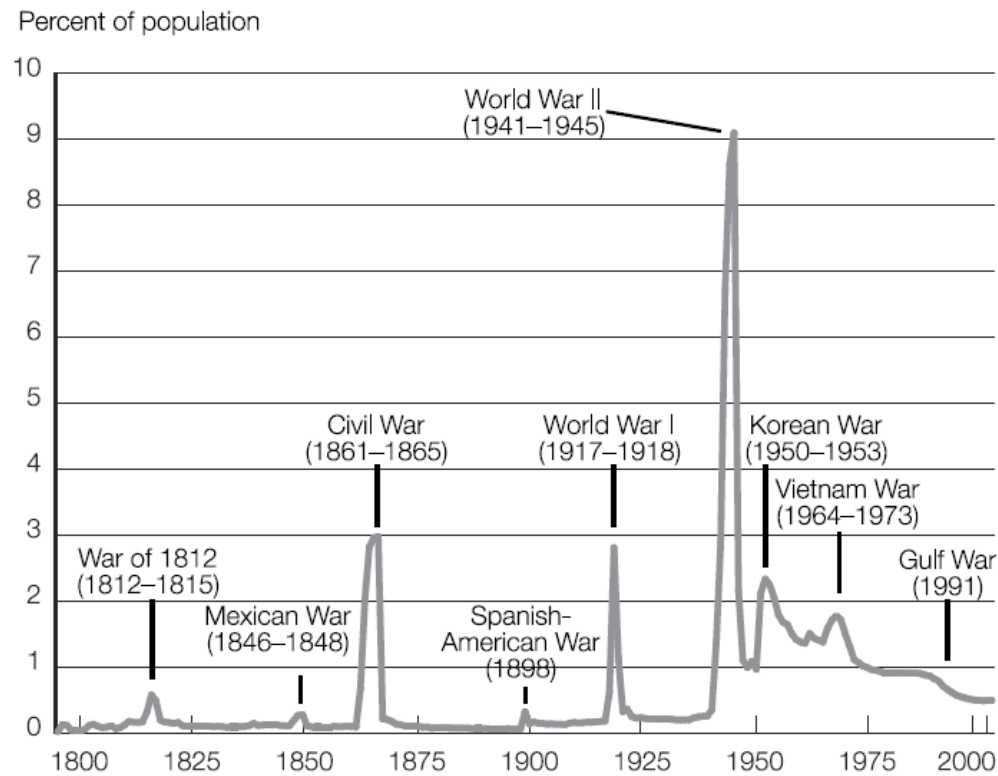
⁷⁹Nick Wingfield and Somini Sengupta, "Drones Set Sights on U.S. Skies," *The New York Times*, http://www.nytimes.com/2012/02/18/technology/drones-with-an-eye-on-the-public-cleared-to-fly.html?pagewanted=all&_r=0 (accessed November 1, 2013).

⁸⁰Wingfield.

⁸¹Rod Powers, "FY 2008 Military Recruiting Statistics," *About.com*, <http://usmilitary.about.com/od/2008recruitingstatistics/a/september.htm> (accessed November 1, 2013).

⁸²Powers.

Figure 10: Participation of the U.S. Armed Forces, 1793-2002



Source: David R. Segal and Mady Wechsler Segal, “America’s Military Population,” *Population Bulletin*, <http://www.prb.org/source/acf1396.pdf> (accessed November 1, 2013).

Strategic Culture

Self Similarity

Both in the government’s actions and in the strategic texts, fiscal constraint and force protection were deemed essential. The current *National Security Strategy* spends two pages discussing the need to “spend taxpayer’s dollars wisely.”⁸³ In response, the *National Defense Strategic Guidance* states that “whenever possible, [the Department of Defense must] develop innovative, low-cost, and small-footprint

⁸³*National Security Strategy*, (Washington, DC: White House, May 2010), 29.

approaches.”⁸⁴ To elaborate, the White House web page states that due to “our economic circumstances” we require “a change in the way that we acquire military equipment and services.”⁸⁵ The effects of the budget cuts continue to impact every facet of the military.

The strategic texts also highlight the necessity of protection. The *National Security Strategy* states that the “Administration has no greater responsibility than *protecting* the American people.”⁸⁶ A key concern defined by the document is “overuse” of the military and a failure to procure necessary tools.⁸⁷ Both the White House website and previous *National Security Strategy* comment on the necessity of unmanned systems directly as necessities. President Obama states, on the White House’s webpage, “we will increase intelligence, surveillance, and reconnaissance (often synonymous with unmanned aerial systems) support for troops in the field and research and development.”⁸⁸ Additionally, the *National Security Strategy* demands the development of “assets such as advanced remote sensing, long range precision strike capabilities.”⁸⁹

Feedback Mechanisms

Methods of feedback to the military and society are uniquely different, as the military feedback is more direct, the societal is indirect. The military receives feedback through strategic guidance outlined in documents such as the National Security Strategy and through Congressional funding allocations. As noted earlier, the strategic guidance indicated the absolute need for the use of UASs. Even with a greatly

⁸⁴Headquarters, Department of Defense, *Sustained U.S. Global Leadership: Priorities for 21st Century Defense*, (Washington, DC: Headquarters Department of Defense, January 2012).

⁸⁵“Defense,” White House.gov, <http://www.whitehouse.gov/issues/defense> (accessed February 23, 2013).

⁸⁶*National Security Strategy*, May 2010, 17.

⁸⁷*National Security Strategy*, May 2010, 17.

⁸⁸“Defense.”

⁸⁹*National Security Strategy*, (Washington, DC: White House, 2002), 29.

reduced defense budget, congressional funding for UASs has remained constant. An easy indication was the 421 percent increase in UAS within the Air Force from 1999 to 2012.⁹⁰

The feedback to society through casualty reduction and conflict avoidance is more difficult to quantify. The difficulty in conflict avoidance lies in the changes in technology over time and the fact that no two conflicts are identical in nature. The closest comparison to the operational environment of Operations Iraqi Freedom (OIF) and Enduring Freedom (OEF) was Vietnam due to its large counterinsurgency component and the technological superiority of the Americans. During the Vietnam War, which lasted from 1955 through 1975, 2,709,918 uniformed service members fought within the Area of Operations.⁹¹ Of those that served in theater, 58,148 were killed.⁹² In contrast, between the years of 2001 and 2012, 2,226,056 service members fought in Iraq or Afghanistan with 6,211 deaths.⁹³ In half the duration, OIF and OEF had less than 10 percent the number of fatalities on the battlefield.

The final feedback mechanism was conflict avoidance. Instead of manned aircraft or boots on ground, the United States government has authorized the introduction of UAS into airspace above multiple countries without creating a public outcry. While most Americans know about UAS utilization in Afghanistan, Iraq, and Libya, few recognize the fact that the U.S. government has authorized them to maneuver over the Philippines, Pakistan, Somalia, Djibouti, Yemen, Mali, Senegal, Niger, and Syria.⁹⁴

⁹⁰“Equipment – 2013 USAF Almanac,” *Air Force Magazine*, May 2013.

⁹¹Marshal Hanson and Scott Beaton, “Vietnam War: Facts, Stats and Myths,” *U.S. Wings*, <http://www.uswings.com/vietnamfacts.asp> (accessed November 01, 2013).

⁹²Hanson.

⁹³“VCS Releases Updated War Statistics,” *Veterans for Common Sense*, <http://veteransforcommonsense.org/2011/12/02/vcs-releases-updated-war-statistics/> (accessed November 1, 2013).

⁹⁴Eric Schmitt, “Drones in Niger Reflect New U.S. Tack on Terrorism,” *The New York Times*, <http://www.nytimes.com/2013/07/11/world/africa/drones-in-niger-reflect-new-us-approach-in-terror-fight.html?pagewanted=1&r=0> (accessed November 1, 2013); Julian E. Barnes, “U.S. Expands Drone Flights to Take Aim at East Africa,” *The Wall Street Journal*,

The roles of the aircraft within these countries included: attacks on terrorists similar to the use in Afghanistan and Iraq; anti-poaching missions in Africa; surveillance of conflict zones; anti-piracy. Despite the capacity for deadly force, the unmanned nature of UAS has created a nearly invisible military tool at the government's disposal.

Summary

The American societal and strategic cultures have definitively aided in the perpetuation of Unmanned Aerial Systems within the military. Society's inherent risk aversion and limited interaction permeate the military systems, in particular UAS, while direct feedback through the media and recruitment propagate these traits. Additionally, the United States government has enhanced dependency through concern over force protection and fiscal constraint. It delivers overt feedback through both the funding of the systems and strategic guidance. Ultimately, the buffered nature of the system will continue to perpetuate the utilization and expansion of the Unmanned Aerial Systems within the military culture.

CASE STUDY 2: SATELLITE COMMUNICATIONS

Satellite communications technology was first prophesized by Arthur C. Clark, a British scientist, in 1945.⁹⁵ His concept was to suspend three "artificial satellites" over the earth to act as repeater stations and provide television or microwave coverage worldwide.⁹⁶ In the 1950s and early 1960s, the National Aeronautical and Space Administration (NASA) conducted experimentation with passive

<http://www.online.wsj.com/news/articles/SB10001424053111904106704576583012923076634> (accessed November 1, 2013); Akbar Ahmed, and Frankie Martin, "Deadly Drone Strike on Muslims in the Southern Philippines," *Brookings*, <http://www.brookings.edu/research/opinions/2012/03/05-drones-philippines-ahmed> (accessed November 1, 2013); and Bill Neely, "Officials: US drones monitoring clashes in Syria," *World News*, <http://www.worldnews.nbcnews.com/news/2012/02/17/10435915-officials-us-drones-monitoring-clashes-in-syria> (accessed November 1, 2013).

⁹⁵James G. Lee, *Air University Space Primer*, (Arkansas: Air University, 2003), 11-1.

⁹⁶Lee, 11-1.

communications satellites which merely reflected signals similar to a mirror.⁹⁷ Then in 1961, NASA, with outside agencies, initiated three programs that successfully developed the first active satellites.⁹⁸ Simultaneously, the military conducted its own testing with little initial success until a working system was created in June 1967.⁹⁹

Though initially for redundancy, the military has always utilized both military owned and operated satellites and commercial satellites for the purposes of communications.¹⁰⁰ From the initial use of MARISAT to the multiple commercial companies utilized today, the dependence on commercial satellites has risen drastically.¹⁰¹ Today over 90 percent of wideband satellite communications for Operation Enduring Freedom are drawn from commercial providers.¹⁰²

Current Military Utility

Today the military utilize two primary forms of satellite communications, voice and digital communications. Both joint and service doctrine discuss their utility and the increasing material requirements. While the *Joint Operating Concept*, the *Transformational Training Guidance*, and the recent *Quadrennial Defense Reviews* describe the necessity of both digital and voice communications, only joint and service doctrine actually annotates the reasons. *Joint Publication (JP) 6-0, Joint Communications Systems*, best annotates the desired usage and has precedence over individual service

⁹⁷Lee, 11-2.

⁹⁸Lee, 11-2.

⁹⁹Lee, 11-2.

¹⁰⁰Don Brown, "2012: A Milestone in the History of Military Satellite Communications on Commercial Satellites," *Intelsatgeneral*, http://www.intelsatgeneral.com/sites/default/files/APSCC%20Q4%202012_Intelsat%20General.pdf (Accessed October 24, 2013).

¹⁰¹Brown.

¹⁰²Brown.

doctrine. In the manual's introduction, satellite communications were labeled a "critical item" in communications planning.¹⁰³ The joint force utilizes Defense Switched Network (DSN), Defense Red Switched Network (DRSN), Enhanced Mobile Satellite Services, and Tactical Voice to enable voice communications.¹⁰⁴ Data services are provided through the joint data network (JDN), Non-Secure Internet Protocol Router Network (NIPRNET), Secret Internet Protocol Router Network (SIPRNET), Coalition/Multinational Worldwide Area Network (WAN), and Joint Worldwide Intelligence Communications Service (JWICS).¹⁰⁵ All of these systems enable a "Global Information Grid" which creates constant information flow despite the individual's location (See Figure 11).¹⁰⁶ Each of these capabilities have critical linkages to satellites based on their individual frequency type (see Figure 11)

Joint force acquisition of satellite communications technology continues to rise. While stationary systems were not uncommon during the initiation of the Global War on Terrorism in 2001, mobile systems were extremely limited. Within the Air Force, almost all aircraft are now equipped with satellite communications (SATCOM) with the B2 bomber's addition recently unveiled.¹⁰⁷ Naval aviation has only recently began its pursuit of SATCOM technology and tested their system in 2012.¹⁰⁸ This new technology has enabled communications redundancy and reach.

¹⁰³Headquarters, Department of Defense. *Joint Communications System, JP6-0*, (Washington, DC: Headquarters Department of Defense, June 2010), xv.

¹⁰⁴Headquarters, Department of Defense, *Joint Communications System*, II-8.

¹⁰⁵Headquarters, Department of Defense, *Joint Communications System*, II-8.

¹⁰⁶Headquarters, Department of Defense, *Joint Communications System*, II-2.

¹⁰⁷"Northrop Grumman moves new B-2 satellite communications concept to higher ground," *Aerotechnews*, <http://www.aerotechnews.com/news/2013/07/08/northrop-grumman-moves-new-b-2-satellite-communications-concept-to-high-ground/> (accessed October 24, 2013).

¹⁰⁸Jeffrey Hill, "Boeing Completes U.S. Navy Aircraft Satcom Demonstration," *Via Satellite*, <http://www.satellitetoday.com/publications/st/2012/06/14/boeing-completes-u-s-navy-aircraft-satcom-demonstration-2/> (accessed October 24, 2013).

The army has had much more rapid acquisition of satellite technology due to decentralized, long range operations in Iraq and Afghanistan. In 2003, the Blue Force Tracker's first satellite based variant, a combined navigation and communications module, was utilized for the first time in Iraq with only 130 systems per brigade.¹⁰⁹ By the end of Operation Iraqi Freedom, nearly every Army and Marine wheeled, tracked, or rotary wing vehicle in theater had a Blue Force Tracker.

Figure 11: Global Information Grid Requirements



Source: Headquarters, Department of Defense. *Joint Communications System. JP6-0*. Washington, DC: Headquarters Department of Defense, June 2010, II-11.

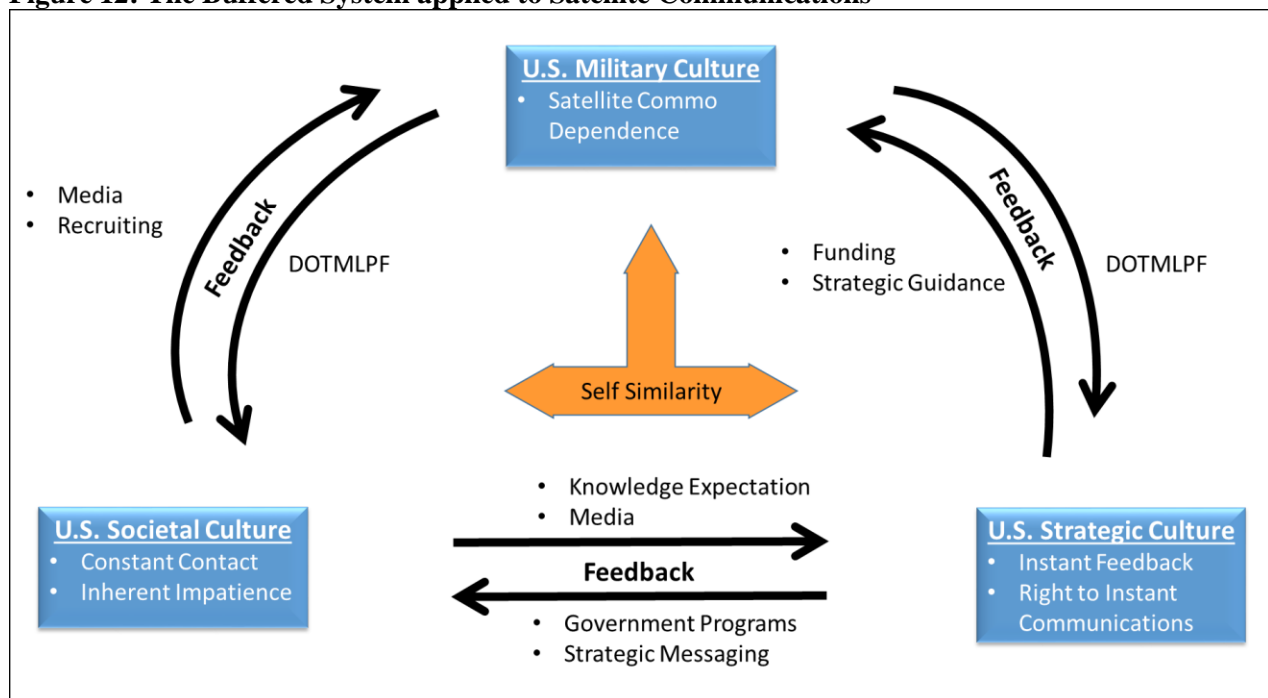
The Buffered System

The buffered system perpetuating the United States Military culture's dependence on satellite communications contains both self-similarity and feedback (see Figure 12). Self-similarity is created through a demand for constant communications and overarching impatience. The feedback within the

¹⁰⁹Roxana Tiron, "Army's Blue-Force Tracking Technology was a Tough Sell," *National Defense*, http://www.nationaldefensemagazine.org/archive/2003/December/Pages/Armys_Blue3685.aspx (accessed October 24, 2013).

system is generated similarly to the previous dependencies. The military provides feedback through DOTMLPF. Society communicates with the military through recruiting and the media, and the government through the media and knowledge expectations. Finally, the government uses strategic messaging with both society and the military, in addition to funding for the military and government programs to society.

Figure 12: The Buffered System applied to Satellite Communications



Source: Author created figure

American Culture

Self Similarity

American societal culture's impact on the military's dependence on satellite communications is not due to societal use of the technology. Societies' self-similarity lies in its desire for constant contact with others and inherent impatience. Prior to the introduction of consumer cellular phone technology in

1983, people were tethered to land line telephones for long distance communications.¹¹⁰ According to the Pew Research Center, the cellphone has both initiated and enabled a desire for constant communications. Currently 91 percent of American adults own cellphones which is a substantial jump from 82 percent in 2011.¹¹¹ Even more surprising, 56 percent of American adults own a smart phone, a substantial leap from the 35 percent two years ago.¹¹² According to a Time Magazine poll, 34 percent of Americans feel they can only be without their phone for several hours at a time (see Figure 13).¹¹³ To punctuate this point, three-quarters of 25 to 29 year olds admitted to actually sleeping with their phones in their beds.¹¹⁴ For frequency, 38 percent of Americans check their phone several times a day, while 14 percent glance at their phones every 10 minutes (see Figure 14).¹¹⁵ These statistics do not reflect an infatuation with the phone or technology in general but an overwhelming need for constant connection to others. This instant connection relates directly to the second driver, a desire for immediate access.

¹¹⁰“The First Mobile Phone Call was Placed 40 Years Ago Today,” *Fox News*, <http://www.foxnews.com/tech/2013/04/03/first-mobile-phone-call-was-placed-40-years-ago-today/> (accessed October 24, 2013).

¹¹¹Mark Rogowsky, “More Than Half of Us Have Smartphones, Giving Apple and Google Much to Smile About,” *Forbes*, <http://www.forbes.com/sites/markrogowsky/2013/06/06/more-than-half-of-us-have-smartphones-giving-apple-and-google-much-to-smile-about/> (accessed October 17, 2013).

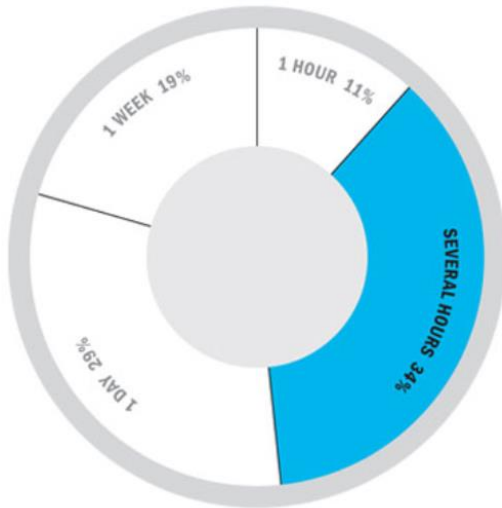
¹¹²Mark Rogowsky.

¹¹³Qualcomm. “Your Wireless Life: Results of TIME’s Mobility Poll,” <http://content.time.com/time/interactive/0,31813,2122187,00.html> (accessed October 22, 2013).

¹¹⁴Nancy Gibbs, “Your Life is Fully Mobile,” *Time*, <http://techland.time.com/2012/08/16/your-life-is-fully-mobile/> (accessed October 22, 2013).

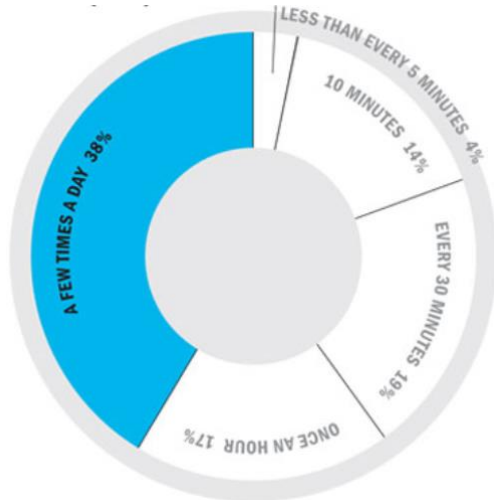
¹¹⁵Nancy Gibbs.

Figure 13: How Long Can Americans Go Without Their Cell Phones?



Source: Qualcomm. “Your Wireless Life: Results of TIME’s Mobility Poll.”
<http://content.time.com/time/interactive/0,31813,2122187,00.html> (accessed October 22, 2013).

Figure 14: How Often Do Americans Check Their Mobile Devices?



Source: Qualcomm. “Your Wireless Life: Results of TIME’s Mobility Poll.”
<http://content.time.com/time/interactive/0,31813,2122187,00.html> (accessed October 22, 2013).

American society’s desire for immediate access manifests itself both in their desires regarding access to news and movie viewership. Static news sources such as newspapers, magazines, and news programs have started to fade. In 2003, print advertising in newspapers yielded 44,939 million dollars in

revenue for print media and only 1,216 for online.¹¹⁶ By 2012, print advertising revenues dropped by well over half, to 18,931 million dollars, while online media over doubled at 3,370 million dollars in advertising revenue (see Figure 15).¹¹⁷ The Washington Post newspaper section, from 2000 to 2012, dropped from a 15 percent profit margin to 9 percent.¹¹⁸ Magazines did not fare much better. From 2003 to 2012, news magazines, excluding Newsweek, ad page revenues dropped 36 percent (see Figure 16).¹¹⁹ More recently, local and national television news viewership has started to wane. From 2006 to 2012, local news viewers have been reduced from 42 percent of adults to 30 percent.¹²⁰ Many of the news outlets have justified the reduction due to a shift to an online marketing model. While this has had an influence, the greater influence has been the impatience of society spawning a desire for instant news. The majority of Americans now gain information through the internet which can update users through multiple means to include social media, blogs, and online news sites.

¹¹⁶Rick Edmunds, Emily Guskin, Amy Mitchell, and Mark Jurkowitz, “The State of the News Media 2013,” *State of the Media*, <http://stateofthemedias.org/2013/newspapers-stabilizing-but-still-threatened/> (accessed October 25, 2013).

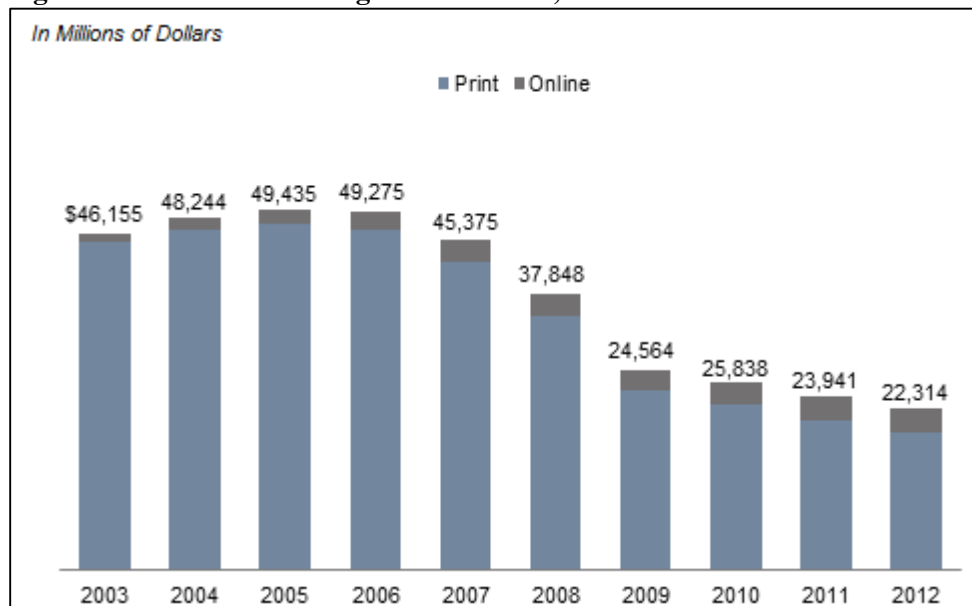
¹¹⁷Edmunds.

¹¹⁸Neil Irwin, “The Decline of Newspapers has been Good for Everyone Else,” *Washington Post*, <http://www.washingtonpost.com/blogs/wonkblog/wp/2013/08/07/the-decline-of-newspapers-has-been-good-for-everybody-else/> (accessed October 24, 2013).

¹¹⁹Katerina Eva Matsa, “News magazines hit by big drop in ad pages,” *Pew Research Center*, <http://www.pewresearch.org/fact-tank/2013/07/15/news-magazines-hit-by-big-drop-in-ad-pages/> (accessed October 25, 2013).

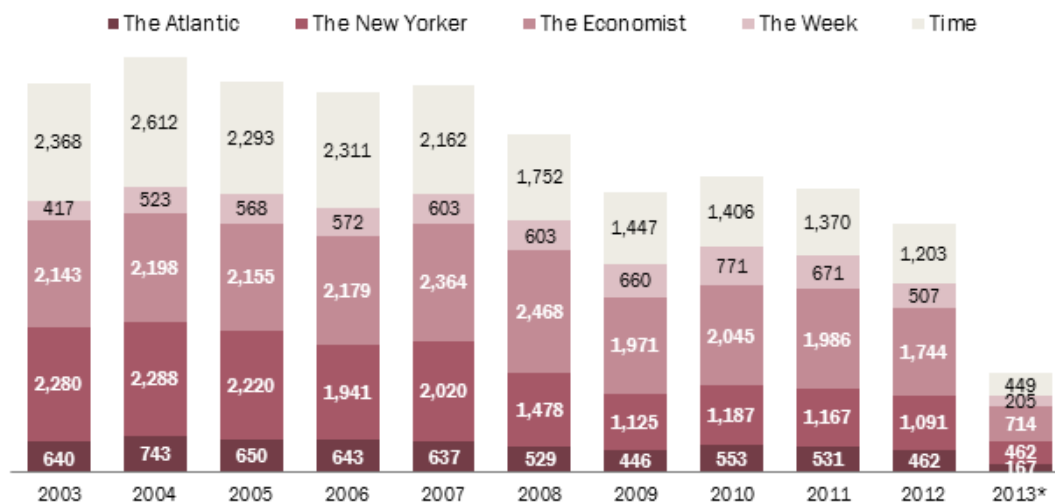
¹²⁰“Overview: State of the News Media 2013,” *The State of the Media*, <http://stateofthemedias.org/2013/overview-5/> (accessed October 25, 2013).

Figure 15: Print Advertising Revenues Fall, Online Grows



Source: Rick Edmunds, Emily Guskin, Amy Mitchell, and Mark Jurkowitz, “The State of the News Media 2013,” *State of the Media*, <http://stateofthemedias.org/2013/newspapers-stabilizing-but-still-threatened/> (accessed October 25, 2013).

Figure 16: Total Number of Magazine Ad Pages



Source: Katerina Eva Matsa, “News magazines hit by big drop in ad pages,” *Pew Research Center*, <http://www.pewresearch.org/fact-tank/2013/07/15/news-magazines-hit-by-big-drop-in-ad-pages/> (accessed October 25, 2013).

Another indicator was the shift in movie viewership methods. Both the internet and the ease of acquiring DVDs have greatly reduced the attendance numbers at theaters and the rentals at physical video rental stores. Even before streaming video’s reputation was established, Americans began shifting from

viewing movies at home rather than at movie theaters. From 1994 to 2006, there was a 6 percent decrease in theater attendance with a 8 percent increase in at home viewership. According to a survey taken by Pew Research Center, 66 percent of Americans claim that the reason for reduced viewership was time constraints while 23 percent refused to drive to the theater due to the hassle (see Figure 17). Physical video rental giant Blockbuster Video continues to diminish in response to a marked drop in video rentals. The reason for the drop was the increase of online streaming video and DVD mail programs provided through companies such as Netflix and Hulu.¹²¹ In 2011 alone, Blockbuster closed 300 stores leaving only 500 locations still functioning.¹²²

Figure 17: The Reasons Against Going to Movie Theaters

	%	%
Reasons you don't go out to movie theater more often		
Just too busy	66	49
Cost	60	52
Easier to wait for DVD	55	61
Too few good movies to see	55	55
Inconvenience of show times	26	23
Hassles of driving and parking	23	29
Don't like the theater	10	37
Number of respondents	401	691

Source: Paul Taylor, Cary Funk, and Peyton Craighill, "Increasingly, Americans Prefer Going to the Movies at Home," *Pew Research Center*, (accessed October 25, 2013), 12.

Feedback Mechanisms

Society provides feedback to both the military and government through the media. Unlike UAS technology, no direct feedback is readily apparent in the media or recruiting trends. The feedback

¹²¹Joanna Stern, "Blockbuster to Close 300 Stores, Killed by Streaming Video," *ABC News*, <http://abcnews.go.com/Technology/blockbuster-close-300-stores-continues-offer-online-video/story?id=18285591> (accessed October 25, 2013).

¹²²Stern.

provided indicates the expectation of instant feedback and an impatience with delayed government answers. In two of the biggest controversies during President Obama's presidency, the public outcry was not necessarily due to the government failure as much as for the seeming lack of knowledge within specific governmental offices. In the first, Operation Fast and Furious, The Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF) intentionally planted guns into the hands of Mexican drug cartels which ultimately resulted in the death of a Border Patrol agent.¹²³ In the second case, the American Ambassador was killed in Benghazi, Libya despite requests for increased security.¹²⁴ Initial questions loomed following both events with a desire to find who knew what and when. Even now, the questions have not been fully answered and the senate continues to investigate. While these cases relate specifically to government, any negative press regarding the military demands the same level of openness and constant contact.

Strategic Culture

Self Similarity

The United States Government has demonstrated its desire for instant feedback and the belief that American citizens have a right to communications. The National Security Council (NSC) and the White House Situation Room display this necessity. Both the NSC and Situation Room provide personal conduits for the president to enable instant understanding regarding the status of America's national security and both have been modified and updated over time to enable this function. The National Security Act of 1947 created the National Security Council to combat growing concerns with the

¹²³Dennis Wagner, "House memo: Entire Fast and Furious mission was a failure," *USA Today*, <http://www.usatoday30.usatoday.com/news/nation/story/2012-02-10-fast-furious/53037494/1> (accessed November 4, 2013).

¹²⁴Bruce Stokes, "The Whole World is Watching," *Pew Research Global Attitudes Project*, <http://www.pewglobal.org/2012/10/22/the-whole-world-is-watching/> (accessed November 4, 2013).

initiation of the Cold War.¹²⁵ The NSC has grown and contracted over time to enable the president access to crucial information in a timely manner from designated representatives. Currently the council consists of over 240 staff members under the National Security Advisor and four statutory members, the President, the Vice President, the Secretary of State, and the Secretary of Defense.¹²⁶

Likewise, the White House Situation Room has changed over time. The Kennedy administration created the Situation Room in 1961 after the abysmal failure in the Bay of Pigs operation.¹²⁷ Initially only a wood paneled conference room with a few telephones, the room today consists of six flat screen televisions with video conferencing and other high tech accoutrements to enable instant data acquisition and display.¹²⁸

During the Reagan administration, the government deemed phone coverage a right of American citizens to enable their safety. As a result, two separate programs, called Lifeline and Link Up America, were initiated.¹²⁹ Lifeline provides discounts on monthly telephone services, while Link Up America contributes a one-time grant to aid in installation fees.¹³⁰ During the Bush administration, the program

¹²⁵“Reforming the National Security Council for the 21st Century: Integrating Homeland Security and Transnational Threats,” *Association of the United States Army*.
http://www.ausa.org/publications/ilw/Documents/DR09-4NationalSecurityCouncil_LOW%20RES0709.pdf (accessed October 25, 2013).

¹²⁶“Reforming the National Security Council for the 21st Century: Integrating Homeland Security and Transnational Threats.”

¹²⁷J.D. Jang, “Inside the Situation Room,” *Whitehouse.gov*,
<http://www.whitehouse.gov/blog/2009/12/18/inside-situation-room> (accessed October 25, 2013).

¹²⁸Jim Rutenberg and David E. Sanger, “Overhaul Moves White House Data Center Into Modern Era,” http://www.nytimes.com/2006/12/19/washington/19bush.html?_r=0 (accessed October 25, 2013).

¹²⁹“Universal Service Support Mechanisms,” *Federal Communications Commission*,
<http://www.fcc.gov/guides/universal-service-support-mechanisms> (accessed October 25, 2013).

¹³⁰“Universal Service Support Mechanisms.”

expanded to include cell phone coverage as well.¹³¹ From 2009 to 2012, the program nearly tripled in size from 800 million to 2.2 billion dollars annually.¹³² Ultimately, the program shows the dedication of the government to ensure that the right of communications is spread nationwide.

Feedback Mechanisms

The government provides feedback to the American public through the the frequency of strategic messaging and the two phone programs, and to the military through strategic guidance and funding. The frequency of strategic messaging provides the constant and timely feedback desired by the public through presidential press conferences and White House press briefings. On average, since President Lyndon Johnson, presidents have held a press conference once a month (see Figure 18).¹³³ President Obama's Press Secretary, Jay Carney, conducts press briefings almost daily. In the month of October 2013, he conducted press conferences on 18 days to appease the public's desire for instant feedback.¹³⁴

¹³¹Karen Tumulty, "Obama phones subsidy program draws new scrutiny on the Hill," *Washington Post*, (accessed October 25, 2013).

¹³²Karen Tumulty, "Obama phones subsidy program draws new scrutiny on the Hill," *Washington Post*, (accessed October 25, 2013).

¹³³Matthew Dickenson, "A Primer on Presidential Conferences," *Presidential Power*, <http://sites.middlebury.edu/presidentialpower/2009/02/10/a-primer-on-presidential-press-conferences> (accessed November 4, 2013).

¹³⁴"Press Briefings," *The White House*, <http://www.whitehouse.gov/briefing-room/press-briefings?page=1> (accessed November 4, 2013).

Figure 18: Presidential Press Conferences

President	Months in Office	Total Press Conferences	Avg. per Year	Avg. per Month
LBJ	62	135	26.16	2.18
Nixon	66	39	7.08	.59
Ford	30	40	15.96	1.33
Carter	48	59	14.76	1.23
Reagan	96	46	5.76	.48
George H.W. Bush	48	142	35.52	2.96
Clinton	96	193	24.12	2.01
George W. Bush (first two years)	24	39	19.44	1.62

Source: Matthew Dickenson, “A Primer on Presidential Conferences,” *Presidential Power*, <http://sites.middlebury.edu/presidentialpower/2009/02/10/a-primer-on-presidential-press-conferences> (accessed November 4, 2013).

Two of the most potent feedback mechanisms to the military are strategic guidance, primarily the National Security Strategy (NSS), and funding. The 2010 NSS indicated the desire for emerging technologies such as the “Internet, wireless networks, [and] mobile-smart-phones” and their necessity in the whole of government approach.¹³⁵ The document also exalted the value of space based technologies and continued expansion into the realm.¹³⁶ In terms of funding, the fact that satellite communications technologies are not identified as potential cuts in spending indicates their observed value to Congress. The current fiscal state has cut many other programs once believed valuable.

Summary

While discrete, American societal and strategic culture plays an integral role in the perpetuation of satellite communications. Society’s desire for constant contact and its inherent impatience translate into many of the underpinnings of the technology’s use. Likewise, the lack of media attention and

¹³⁵*National Security Strategy*, (Washington, DC: White House, May 2010), 39.

¹³⁶*National Security Strategy*, (Washington, DC: White House, May 2010), 31.

continuity in recruiting efforts eliminates any possible resistance. Similar to society, government's desire for instant feedback has driven the dependency. Its stated goals through the National Security Strategic and continued funding of the initiative provide positive feedback. As indicated, the system continues to enable the military reliance on satellite communications and will likely continue the growth seen over the past decade.

CASE STUDY 3: GLOBAL POSITIONING SYSTEMS

In 1973, the Applied Physics Laboratory at Johns Hopkins University developed the first navigation satellite for updating the inertial navigation systems of the U.S. Navy's Polaris submarines.¹³⁷ This initial system, "Transit," remained online providing access to both military and civilian users until December 1996.¹³⁸ The deactivation was due to its replacement's, Navigation Satellite Timing and Ranging Global Positioning System (NAVSTAR GPS), becoming operational.¹³⁹ This system, comprised of 24 satellites in six orbital planes, initially contained a degradation capacity for civilian users.¹⁴⁰ On May 1, 2000, the degradation was eliminated giving equal access to both military and civilian users.¹⁴¹ The U.S. Air Force and the Department of Transportation, with the Air Force as the executive agent, now jointly control the system.¹⁴²

¹³⁷Lee, 14-1.

¹³⁸Lee, 14-1.

¹³⁹Lee, 14-1.

¹⁴⁰Lee, 14-1.

¹⁴¹William Reynish, "The Real Reason Selective Availability Was Turned Off," Avionics Today, http://www.aviationtoday.com/av/issue/feature/The-Real-Reason-Selective-Availability-Was-Turned-Off_12739.html#.UmAyfRQo7Y8 (accessed October 17, 2013).

¹⁴²Lee, 14-1.

Current Military Utility

Currently the United States military utilizes the technology for navigation, and guidance systems.¹⁴³ At the tactical level, the military uses Precision Lightweight GPS Receivers (PLGRs) or Defense Advanced GPS Receivers (DAGRs) for navigation.¹⁴⁴ These systems also integrate into other component and joint systems, both aerial and ground, to enable navigation by the user, synchronized timing, and tracking by higher echelons.

Guidance systems integrated in aircraft, ships, and land based vehicles and many of their munitions have increased both accuracy and lethality of long range fires. The Conventional Air Launched Cruise Missiles (CALCMs), the Navy's Tactical Land Attack Missile (TLAM), the Army's GPS Multiple Launch Rocket System (GMLRS), and Intercontinental Ballistic Missiles (ICBM) all rely heavily on GPS technology for accuracy.¹⁴⁵ Even the B2 bomber currently uses the GPS-Aided Targeting System (GATS) to accurately locate targets and drop Joint Direct Attack Munitions (JDAMS) with precision.¹⁴⁶

The Buffered System

Self-similarity and feedback within the system help identify the factors perpetuating the United States Military culture's dependence on global positioning system (GPS) technology (see Figure 19). Self-similarity is generated through two separate relationships, the desire for convenience and societal GPS dependency. The feedback within the system is generated similarly to the previous dependencies. The military provides feedback through DOTMLPF. Society communicates with the military through recruiting and the media, and the government through the media alone. Finally, the government uses strategic messaging to both, in addition to funding for the military and government benefits to society.

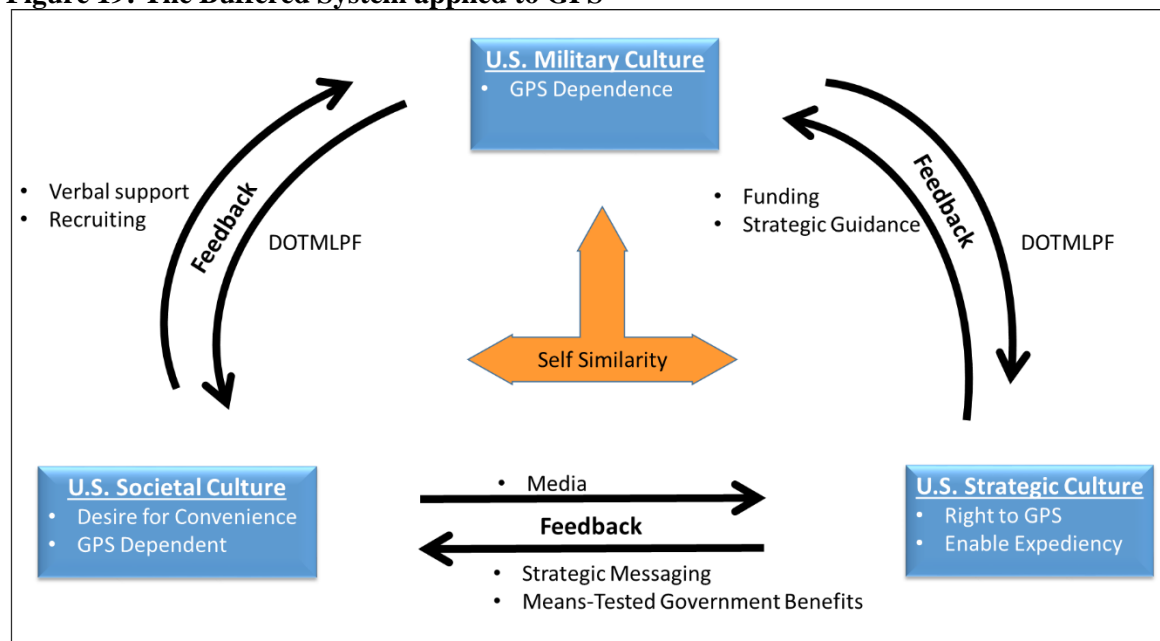
¹⁴³Lee, 14-2.

¹⁴⁴Lee, 14-11.

¹⁴⁵Lee, 14-11.

¹⁴⁶Lee, 14-11.

Figure 19: The Buffered System applied to GPS



Source: Author created figure

American Culture

Self Similarity

While having an indirect impact through its desire for convenience, American society has had a more direct impact on GPS technology than in Unmanned Aerial Systems or satellite communications. The United States populace and industry have fully embraced GPS technology over the past fifteen years. While once a novelty for ordinary U.S. citizens, by the early 2000s, a simple NAVSTAR GPS set cost close to \$100 dollars and there were over 700 different models.¹⁴⁷ By 2010, over 500 million units had been produced for commercial consumers and the number is estimated to hit 1.1 billion in 2014.¹⁴⁸ With their integrated GPS, today's "smart phone" owners create a situation in which well over 50% of American adults now own GPSs.¹⁴⁹

¹⁴⁷Lee, 14-1.

¹⁴⁸Jeff Robbins, *Cases on Emerging Information Technology, Research and Applications*, (Pennsylvania: Information Science Reference, 2013), 89.

In addition to individual use, industry uses GPS for public health and safety, aviation, survey/mapping, scientific research, transportation, maritime navigation, agriculture, and manufacturing.¹⁵⁰ In agriculture, farmers use satellite positioning to program their equipment to autonomously distribute fertilizer across their property based on soil composition and the previous season's yields.¹⁵¹ Shipping companies use GPS to track their drivers and manage efficiency.¹⁵² The precision timing produced by the GPS system is crucial in running electric grids by timing surges and in financial firms by providing continuity in reference times.¹⁵³ Emergency workers also rely on navigation systems to enable rapid movement to disaster scenes.¹⁵⁴

As the usage of GPS technology has increased, dependency has followed, while redundancy has diminished. Fewer and fewer physical maps are seen in American vehicles as their digital counterparts replace them. Utilization of paper maps has diminished to the point that in 2009 the state of Washington's Department of Transportation stopped printing maps.¹⁵⁵ As the number of maps diminish, American society's ability to navigate by map regresses as well.

¹⁴⁹Mark Rogowsky, "More Than Half of Us Have Smartphones, Giving Apple and Google Much to Smile About," *Forbes*, <http://www.forbes.com/sites/markrogowsky/2013/06/06/more-than-half-of-us-have-smartphones-giving-apple-and-google-much-to-smile-about/> (accessed October 17, 2013).

¹⁵⁰Lee, 14-2.

¹⁵¹Leah Binkovitz, "What is the Future of GPS? Are We Too Dependent?" *Smithsonian*, <http://blogs.smithsonianmag.com/aroundthemall/2013/04/qa-what-is-the-future-of-gps-are-we-too-dependent/> (accessed October 17, 2013).

¹⁵²Binkovitz.

¹⁵³Binkovitz.

¹⁵⁴Binkovitz.

¹⁵⁵Bill Virgin, "Travel: The Decline of Washington State Paper Maps," *Tri-City Herald*, <http://www.tri-cityherald.com/2012/03/04/1850726/travel-the-decline-of-washington.html>. (Accessed October 17, 2013).

While less influential, the American desire for convenience influences both societal and the military's dependence on GPS. Banking, shopping, and food consumption trends are microcosms of the overarching trend. Personal banking has drastically shifted from physical interaction in established banks to primarily online exchanges. From 2000 to 2002 alone, online banking saw a 164 percent increase in participants.¹⁵⁶ This number has continued to grow exponentially. Eight of ten transitioning online bankers claimed that the convenience factor was the primary reason for the transition.¹⁵⁷

During the same timeframe, online shopping increased by 78 percent.¹⁵⁸ The convenience provided has enabled the rise of market giants, such as Amazon. Amazon's market value is currently \$79 billion dollars, 40 percent higher than the combined value of Target and Kohls, who combined have 2,800 stores.¹⁵⁹ Overall, between 2002 and 2008, e-commerce grew by over 120 percent while offline grew 30 percent.¹⁶⁰

American societal food consumption indicates the desire for expediency through where and what people eat. There are currently over 160,000 fast food restaurants in America with 50 million served daily.¹⁶¹ On average, 44 percent of Americans visit a fast food restaurant at least once a week and 20

¹⁵⁶Susannah Fox, "Online Banking 2002," *Pew Internet*, <http://www.pewinternet.org/Reports/2002/Online-Banking-2002/Data-Memo.aspx> (accessed November 18, 2013).

¹⁵⁷Fox.

¹⁵⁸Fox.

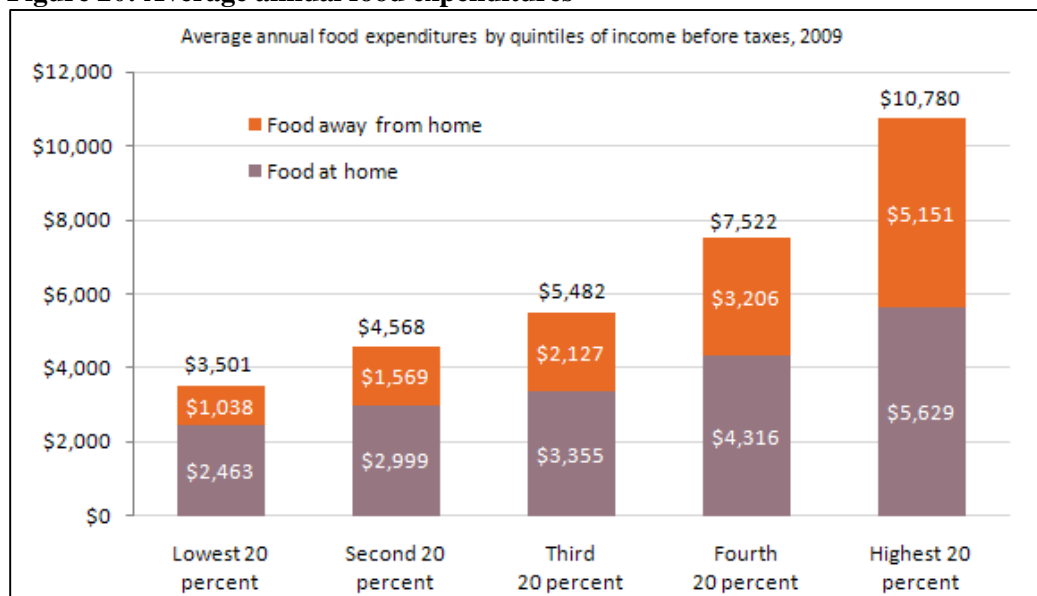
¹⁵⁹Ethan Lieber and Chad Syverson, "Online versus Offline Competition," *Oxford Handbook of the Digital Economy*, <http://faculty.chicagobooth.edu/chad.syverson/research/onlinevsoffline.pdf> (accessed October 25, 2013), 1.

¹⁶⁰Lieber, 2.

¹⁶¹"Fast Food Statistics," *Statistic Brain*, <http://www.statisticbrain.com/fast-food-statistics/> (accessed October 25, 2013).

percent twice.¹⁶² This is indicative of the overall trend to eat out. A large portion of society spends more than half of the money spent on sustenance in restaurants (see Figure 20).¹⁶³ When looking at what Americans eat, processed food and junk food consumption indicate their desires. To lessen preparation time, regardless of health effects, the average American diet currently consists of 70 percent processed foods.¹⁶⁴ Cooking from scratch has been deemed either too difficult or time consuming. Surprisingly the number one reason given for eating junk food was convenience at 73 percent of the population (see Figure 21).¹⁶⁵

Figure 20: Average annual food expenditures



Source: “Food for Thought,” *U.S. Bureau of Labor Statistics*, <http://www.bls.gov/spotlight/2010/food/pdf/food.pdf> (accessed October 26, 2013).

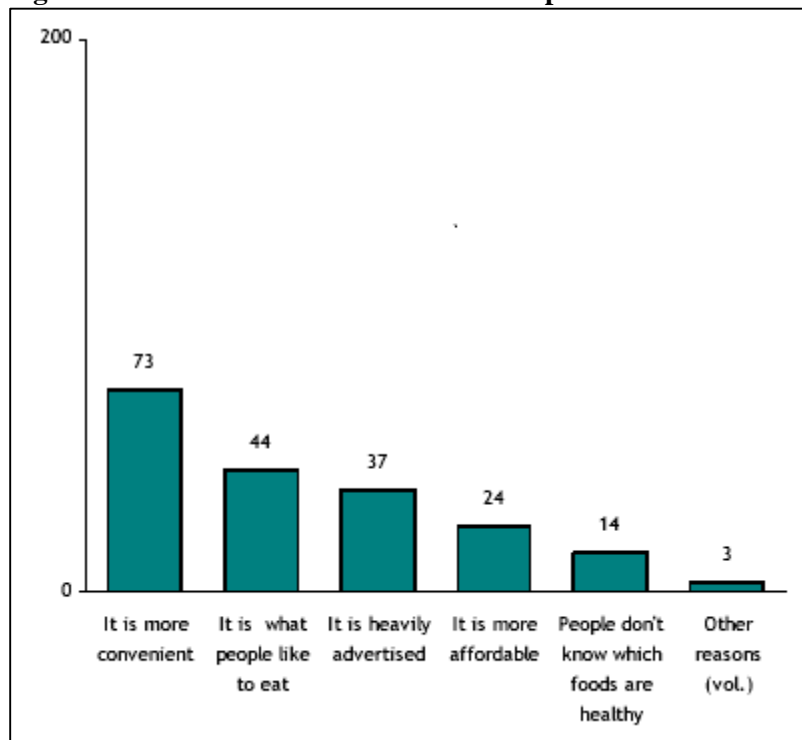
¹⁶²“Fast Food Statistics.”

¹⁶³“Food for Thought,” *U.S. Bureau of Labor Statistics*, <http://www.bls.gov/spotlight/2010/food/pdf/food.pdf> (accessed October 26, 2013).

¹⁶⁴Kai Ryssdal, “Processed foods make up 70 percent of the US diet,” *Marketplace*, <http://marketplace.org/topics/life/big-book/processed-foods-make-70-percent-us-diet> (accessed October 26, 2013).

¹⁶⁵“Eating more, enjoying less,” *Pew Research*, <http://www.pewsocialtrends.org/2006/04/19/eating-more-enjoying-less/> (accessed October 26, 2013).

Figure 21: Reasons for Junk Food Consumption

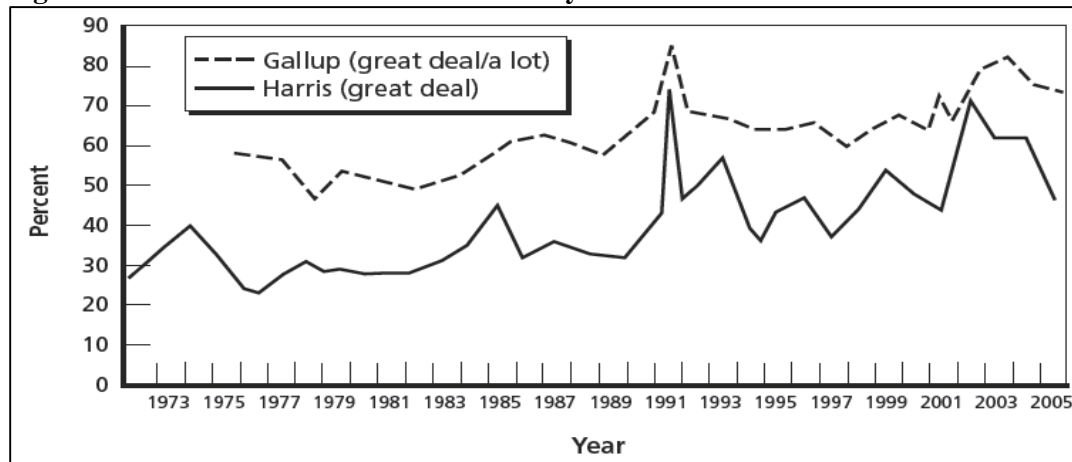


Source: “Eating more, enjoying less,” *Pew Research*, <http://www.pewsocialtrends.org/2006/04/19/eating-more-enjoying-less/> (accessed October 26, 2013).

Feedback Mechanisms

Society continues to deliver feedback to the military through both the media and steady recruiting numbers, while it distributes government feedback through the media alone. While recruiting feedback mirrors that of satellite communications and UAS, the media feedback is based on the public’s confidence in the military. There has been a drastic increase in confidence as the Army continued to mature from the early 1970s to the mid-2000s (see Figure 22). This confidence indicates a general satisfaction with the way in which the military is going and the systems that it currently employs.

Figure 22: Societal Confidence in the Military



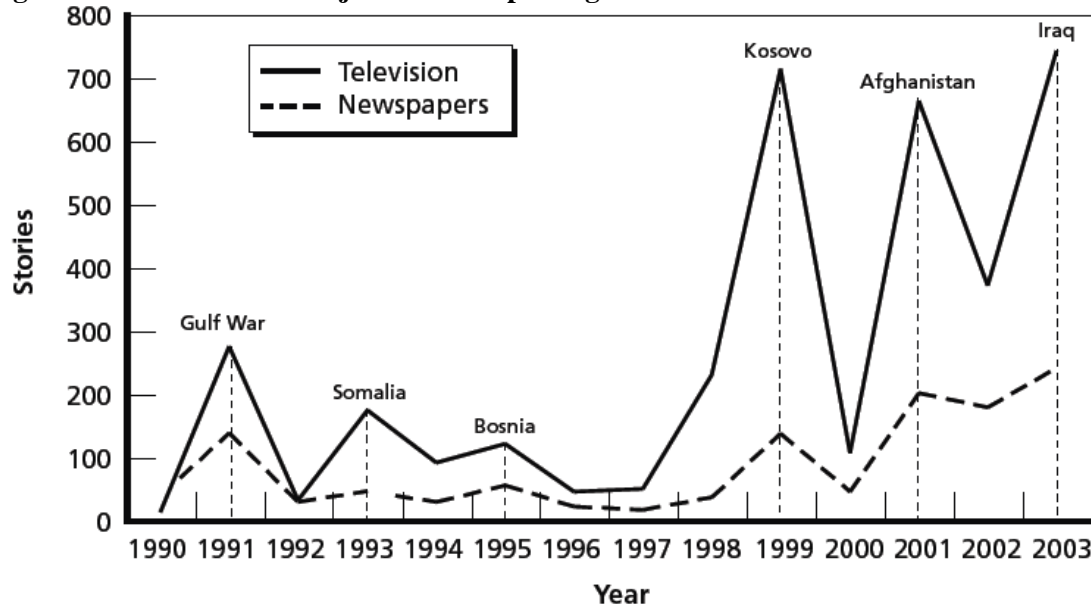
Source: Eric V. Larson, and Bogdan Savych, *Misfortunes of War: Press and Public Reactions to Civilian Deaths in Wartime*, California: RAND, 2006, 210.

Government feedback is slightly more nuanced and centers around casualty reductions based on GPS guidance systems. Over the past 20 years, public interest in civilian casualties has consistently risen (see Figure 23). This attention is due to the increased concern over collateral damage. As early as 1999, 79 percent of Americans felt that civilian casualties should be a primary concern when looking at how to employ the military.¹⁶⁶ In terms of UAS utilization, Americans indicated that collateral damage should be the top concern (see Figure 24).¹⁶⁷ The concern over civilian casualties helped solidify the importance of precision munitions which could help avert the collateral damage.

¹⁶⁶Eric V. Larson and Bogdan Savych, *Misfortunes of War: Press and Public Reactions to Civilian Deaths in Wartime*, (California: RAND, 2006), 4.

¹⁶⁷Bruce Drake, “Obama and drone strikes: Support but questions at home, opposition abroad,” *Pew Research Center*, <http://www.pewresearch.org/fact-tank/2013/05/24/obama-and-drone-strikes-support-but-questions-at-home-opposition-abroad/> (accessed November 12, 2013).

Figure 23: United States Major Media Reporting on Civilian Casualties



Source:

Eric V. Larson and Bogdan Savych, *Misfortunes of War: Press and Public Reactions to Civilian Deaths in Wartime*, California: RAND, 2006, 2

Figure 24: American Society's Concerns Regarding UAS

How concerned are you about whether drones...	Very %	Somewhat %	Not too %	Not at all %	DK %
Endanger civilian lives	53	28	8	7	4=100
Lead to retaliation from extremists	32	33	17	14	4=100
Are conducted legally	31	35	13	15	7=100
Damage America's reputation	26	31	18	20	5=100

PEW RESEARCH CENTER Feb. 7-10, 2013. Figures may not add to 100% because of rounding.

Drake, Bruce. "Obama and drone strikes: Support but questions at home, opposition abroad," *Pew Research Center*, <http://www.pewresearch.org/fact-tank/2013/05/24/obama-and-drone-strikes-support-but-questions-at-home-opposition-abroad/> (accessed November 12, 2013).

Strategic Culture

Self Similarity

Similar to the American societal culture, the United States government has influenced GPS dependence both through the actual system itself and through an indirect influence. Since GPSs unveiling

in 1973, the government has ensured the dual use policy to enable both military and civilian utilization.¹⁶⁸ The Clinton administration made the largest contributions to civilian GPS use. Initially, in 1999, Vice President Gore announced a 400 million dollar initiative that would modernize the GPS system and add two new civilian signals to future satellites which would enhance user capabilities. Then on May 1, 2000, President Clinton removed the accuracy degrading “selective availability” enabling all users, military and civilian, the same access to the system.¹⁶⁹

The government has indirectly influenced the dependence on GPS technology by incentivizing American convenience through the perpetuation of government dependence. The Heritage Foundation conducted a study gauging American dependence on the government from 1962 to 2008. They used an index based on American dependence on assistance for housing, health and welfare, retirement, education, and rural and agricultural services (see Figure 25).¹⁷⁰ Analysis of the index indicates that the American dependence on government has increased by 1,263 percent over the 46 years evaluated.¹⁷¹

Much of this expediency stemmed from the ease of receiving government health and welfare, particularly in welfare, food stamps, and AFCD (Aid to Families with Dependent Children). In 2011, for every 1.65 Americans working in the private sector, 1 person was receiving welfare from the government.¹⁷² In thirty-nine states, welfare pays more than an 8 dollar an hour job, while in six states it

¹⁶⁸Lee, 14-1.

¹⁶⁹William Reynish, “The Real Reason Selective Availability Was Turned Off,” *Avionics Today*, http://www.aviationtoday.com/av/issue/feature/The-Real-Reason-Selective-Availability-Was-Turned-Off_12739.html#.UmAyfRQo7Y8 (accessed October 17, 2013).

¹⁷⁰William W. Beech, “The 2009 Index of Dependence on Government,” *The Heritage Foundation*, <http://www.heritage.org/research/reports/2010/03/the-2009-index-of-dependence-on-government> (accessed October 27, 2013).

¹⁷¹Beech.

¹⁷²Tyler Durden, “When Work is Punished: the Tragedy of America’s Welfare State,” *Zerohedge*, <http://www.zerohedge.com/news/2012-11-27/when-work-punished-tragedy-americas-welfare-state> (accessed October 28, 2013).

pays more than a 12 dollar an hour job.¹⁷³ To put this in perspective, the money received in eight states through welfare exceeds that salary of an average teacher.¹⁷⁴ In 2012, while 12.8 million Americans received welfare, 46.7 million utilized food stamps.¹⁷⁵ This number represented 15 percent of the American population.¹⁷⁶ In 2011, for every worker, working full time year round, there were 1.07 means-tested government benefit recipients.¹⁷⁷ Finally, AFCD's normal duration indicates the perpetual nature of the programs. Of those who enter the program, only 19 percent less remain in the program for less than 7 months.¹⁷⁸ In converse, a higher percentage, 19.6 percent, remain in the program for over 5 years.¹⁷⁹

¹⁷³“Welfare Statistics,” *Statistic Brain*, <http://www.statisticbrain.com/welfare-statistics/> (accessed October 28, 2013).

¹⁷⁴“Welfare Statistics.”

¹⁷⁵“Welfare Statistics.”

¹⁷⁶“Welfare Statistics.”

¹⁷⁷Terence P. Jeffrey, “Census Bureau: Means-Tested Gov't Benefit Recipients Outnumber Full-Time Year-Round Workers,” *CNS News*, <http://m.cnsnews.com/news/article/terence-p-jeffrey/census-bureau-means-tested-govt-benefit-recipients-outnumber-full#sthash.tMO0bXQ1.dpuf> (accessed October 30, 2013).

¹⁷⁸“Welfare Statistics.”

¹⁷⁹“Welfare Statistics.”

Figure 25: Index of Dependence on Government

Year	Housing	Health and Welfare	Retirement	Education	Rural and Agricultural Services	Index Value	Annual Percentage Change in Index Value
1962	1	6	5	2	5	19	
1963	1	6	5	2	6	21	11.75%
1964	1	6	5	2	7	22	2.77%
1965	2	6	6	2	6	22	-0.49%
1966	2	7	6	4	4	23	6.05%
1967	2	8	7	7	5	28	22.29%
1968	2	9	8	9	6	34	21.34%
1969	2	10	9	7	7	36	4.95%
1970	3	11	9	8	7	38	7.47%
1971	4	14	11	7	7	43	12.14%
1972	6	17	11	7	8	49	13.73%
1973	9	15	13	6	8	51	4.80%
1974	9	16	14	5	5	49	-5.11%
1975	9	21	15	7	5	57	17.09%
1976	14	24	16	8	6	69	20.84%
1977	20	23	18	9	9	78	13.44%
1978	22	22	18	10	13	86	10.00%
1979	25	22	19	12	12	90	5.15%
1980*	30	25	20	15	10	100	10.52%
1981	34	26	22	18	10	109	9.27%
1982	34	25	23	14	10	106	-3.35%
1983	36	26	24	13	12	112	6.12%
1984	38	24	25	13	8	108	-3.42%
1985	38	25	26	14	13	115	6.21%
1986	38	26	27	14	14	118	3.02%
1987	36	26	27	12	11	113	-4.28%
1988	38	27	28	13	8	114	0.24%
1989	38	28	29	16	7	118	4.12%
1990	39	31	30	16	7	123	3.79%
1991	40	37	31	17	7	132	7.34%
1992	42	45	33	16	7	143	8.27%
1993	47	47	35	20	9	157	10.22%
1994	51	48	36	11	8	154	-1.89%
1995	58	50	38	19	6	170	10.21%
1996	56	50	39	16	6	167	-1.81%
1997	56	49	41	16	6	168	0.69%
1998	58	50	42	15	6	171	1.65%
1999	55	53	41	13	10	173	1.09%
2000	56	55	42	12	13	179	3.79%
2001	57	59	44	12	11	183	2.07%
2002	62	68	46	20	10	206	12.46%
2003	64	73	48	26	12	223	8.45%
2004	64	74	49	28	8	224	0.37%
2005	63	75	51	34	15	237	5.98%
2006	62	73	53	52	21	261	9.87%
2007	70	74	56	25	12	237	-9.08%
2008	67	81	58	24	10	240	1.16%

* Base year

Source: William W. Beech, "The 2009 Index of Dependence on Government," *The Heritage Foundation*, <http://www.heritage.org/research/reports/2010/03/the-2009-index-of-dependence-on-government> (accessed October 27, 2013).

Feedback Mechanisms

Government feedback to society mirrored its self-similarity in strategic messaging and means-tested government benefits, while the military feedback was provided through strategic guidance and funding. The Clinton administration's multiple press conferences touting GPS technology and eliminating the degradation was the most direct feedback. To support societal desires for convenience, the federal government continues to expand the benefits provided to American citizens.

Two of the most crucial feedback mechanisms to military were the National Security Strategy (NSS) and funding. For GPS systems and their offshoots such as precision munitions, the lack of

acknowledgement in both the funding documents and NSS indicate a steady state utilization rather than a reduction.

Summary

With its dual use nature, global positioning system technology poses a different type of dependency issue. While punctuated by its desire for convenience, society's greatest influence is its own dependence on the navigational technology in both industry and daily life. Additionally, it provides feedback through the media and continued military recruiting numbers. Government enhances society's influence through its policies, which have both enabled the GPS dual use phenomena and eased the ability to acquire government assistance. To further its influence, the government continues to fund all GPS related programs regardless of the fiscal circumstances. Due to the integrated nature of the actual technology within American societal and strategic culture, the buffering within the system is the strongest of the three.

CONCLUSION AND RECOMMENDATIONS

In *The Art of War*, Sun Tzu, proclaimed "If you know the enemy and know yourself, you need not fear the result of a hundred battles."¹⁸⁰ This study has provided a lens to scrutinize and better understand the United States military's dependency on satellite technology. Typically, the military evaluates its performance and equipping in terms of historic vignettes provided through both its own history and that of others. Rarely does it look at possible repercussions of societal and strategic culture. The three cases within this study, unmanned aerial systems, satellite communications, and global positioning system technology, illuminate the potency of their individual characteristics and their direct feedback to the military. These microcosms indicate that the well buffered system composed of strategic, societal, and military culture creates an emergent dependency on satellite technology.

¹⁸⁰Sun Tzu, *Art of War*, Translated by Ralph D. Sawyer, Boulder, CO: Westview Press, 1994, 52.

Conclusion

Chinese Colonels Leang and Xiangsui lamented that, “Only from the perspective of mankind can mankind clearly perceive the essence of technology as a tool, and only then can he avoid becoming a slave to technology – to the tool – during the process of resolving the difficult problems he faces in his existence.”¹⁸¹ To avoid “slavery” to technology, the American military must refuse to discount the overarching impact of societal and strategic culture’s impact on satellite technology. The dependency within the technologies is continuing to grow and expand exponentially as the military addresses the future hybrid threat. If unchecked, this tactical dependency could ultimately catalyze a strategic defeat. While difficult to control, the perpetuation of this dependency through the intertwined American Strategic-Societal-Military Culture System must be addressed when attempting to counter its expansive effects.

Recommendations

The military’s own buffered system, framed in terms of DOTMLPF (doctrine, organization, training, material, leadership, personnel, and facilities), can provide a counterbalance to the detriment imposed by the buffering of the strategic-social-military system. In his book *Anti-Fragile*, Nassim Taleb, argues a concept beyond buffering, which he calls antifragility.¹⁸² He equates the two to organic and inorganic structures. The organic system needs negative stressors to enhance itself while these same stressors eventually destroy the inorganic.¹⁸³ Despite their original application to financial institutions,

¹⁸¹Liang, 3.

¹⁸²Nassim Nicholas Taleb, *Antifragile*, Kiruks Media LLC, 2013, 17.

¹⁸³Taleb, 17.

five of Taleb's six principles of antifragility provide possible means of creating positive system changes in the military (see Figure 23).¹⁸⁴

Figure 26: Six Principles of Antifragility

- | | |
|----|--|
| 1. | Profit from turmoil |
| 2. | Embrace trial and error |
| 3. | Time decreases fragility |
| 4. | Improvement through removal |
| 5. | The 20% zero-risk, 80% high-risk portfolio |
| 6. | Skin in the game |

Source: Adapted from Ben Huebscher, "Nassim Taleb on the Anti-Fragile Portfolio and the Benefits of Taking Risks," *Advisor Perspectives*.

[http://www.advisorperspectives.com/newsletters13/pdfs/Nassim Taleb on the Anti-Fragile Portfolio.pdf](http://www.advisorperspectives.com/newsletters13/pdfs/Nassim_Taleb_on_the_Anti-Fragile_Portfolio.pdf) (accessed December 5, 2013).

Taleb's first principle, profit from turmoil, states that unfavorable circumstances and uncertainty have potential for profit if harnessed.¹⁸⁵ The military must evaluate all issues with satellite based technology over the span of their use, especially in combat operations to look for possible solutions. Despite frustration at the time, UAS crashes from lost satellite links, GPS disruption, and satellite communication failures can illuminate repercussions of dependency and possible methods for countering it if properly captured. While failure in combat is the least preferred method of change, its potency can enable substantial positive changes.

The second principle, embracing trial and error, discusses intentionally attempting to produce system failure to test fragility.¹⁸⁶ The military utility for this principle lies in training and testing. This

¹⁸⁴Ben Huebscher, "Nassim Taleb on the Anti-Fragile Portfolio and the Benefits of Taking Risks," *Advisor Perspectives*, [http://www.advisorperspectives.com/newsletters13/pdfs/Nassim Taleb on the Anti-Fragile Portfolio.pdf](http://www.advisorperspectives.com/newsletters13/pdfs/Nassim_Taleb_on_the_Anti-Fragile_Portfolio.pdf) (accessed December 5, 2013).

¹⁸⁵Huebscher.

¹⁸⁶Huebscher.

method intentionally creates issues to enable the illumination of vulnerabilities and alternatives. The military can utilize training in two ways to create this artificial environment, through harsh utilization to initiate system failure or by artificially creating failure through the training plan. These methods both illuminate unforeseen repercussions and possible redundancy that can be enacted.

The third principle, time decreases fragility, indicates that antifragile systems self-actualize over time decreasing their fragility.¹⁸⁷ While it is reassuring that the military will probably counter deficiencies over time, risk must be weighed. If satellite dependence is not naturally corrected for twenty years, what is the likelihood that a near peer competitor will emerge prior? Most would agree that the risk does not justify the method.

The fifth principle, the 20 percent zero-risk, 80 percent high-risk portfolio, claims that broad diversification with an impervious backdrop yields the greatest results.¹⁸⁸ While not necessarily correct in the exact percentages, when gauging both training focus and equipment acquisitions military leaders must seriously consider the balancing of vulnerable versus invulnerable systems and training priorities. For example, due to its vulnerability, a balanced approach should be taken between land navigation training with a hand held GPS and with a compass. Likewise, the number of traditional scouts and UASs employed must be evaluated.

The sixth and final principle, skin in the game, indicates that without personal investment in something, the endeavor is doomed to fail.¹⁸⁹ This principle should be applied to every aspect of the DOTMLPF. With two simultaneous conflicts, many functions traditionally performed by uniformed service members have been outsourced to civilian employees or contractors. Just as parachute riggers are inclined to take their profession seriously due to their obligation to randomly jump one of their chutes

¹⁸⁷Huebscher.

¹⁸⁸Huebscher.

¹⁸⁹Huebscher.

periodically, every part of the military should feel the same impetus. Even with the draw down, military professionals must integrate into every aspect of the DOTMLPF.

By integrating these principles into the military mindset, the buffering within the military system may overcome the strong influence of the strategic-societal-military culture system. If the military fails to address the dependence on satellite technology, ultimately tactical defeat may follow. To modify the well-known moniker, “Knowing is [only] half the battle.”

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